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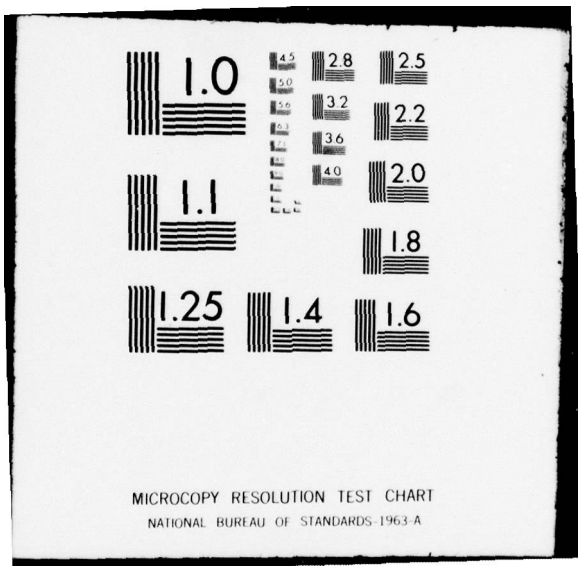
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LEVEL II 2

DEVELOPMENT AND APPLICATION OF A TASK TAXONOMY FOR TACTICAL FLYING

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A taxonomy of tactical flying skills was developed as a user oriented skill-task analysis system for practical application in solving TAC continuation training problems and for a behavioral data base for skill maintenance and reacquisition training research and development. Sixteen representative tactical air-to-air and air-to-surface maneuvers were analyzed and classified within the system with provision for later expansion.

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SUMMARY

This is Volume III of a three volume report which describes the development and application of a taxonomy of tactical flying tasks. Volumes I and II present detailed procedures for analyzing and classifying tasks within a taxonomic system. Volume III is comprised of a series of reports which describe the application of the taxonomic system to a variety of operational training problems. In each of these reports the authors describe the problem, the specific procedures by which the taxonomy was applied, and the results obtained.

The number and type of problems treated in Volume III is only representative of the potential uses of the taxonomy in addressing a wide range of requirements. The problems were selected by training personnel at the 4444th Operations Squadron at Luke AFB as typical of the kinds of issues involved in operational training for the F-4E aircraft.

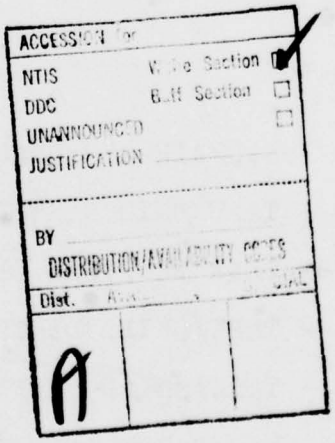


TABLE OF CONTENTS

PREFACE	6
INTRODUCTION	7
APPLICATION OF THE TAXONOMIC DATA SYSTEM TO TACTICAL FLYING TRAINING	9
INFORMATIONAL ANALYSIS FOR THE MAINTENANCE OF TACTICAL FLYING SKILLS	13
INFORMATIONAL ANALYSIS OF THE POP-UP TASK	29
AIR-TO-AIR AND AIR-TO-GROUND TASK SEQUENCING METHODOLOGY	41
METHODOLOGY TO DETERMINE SIMULATOR CAPABILITY REQUIREMENTS	52
METHODOLOGY TO DETERMINE SIMULATOR TASK/SKILL TRAINING CAPABILITY	59
METHODOLOGY TO DETERMINE MOTION SIMULATION CONTRIBUTIONS AND LIMITATIONS IN TRAINERS	65
CONCLUDING STATEMENT	73
REFERENCES	75
GLOSSARY	76
APPENDIX A - AIR/AIR-AIR/GROUND BROAD SCOPE ANALYSIS	79
APPENDIX B - TAXONOMIC SYSTEM DATA	105
APPENDIX C - TASK PROFILES OF REPRESENTATIVE TASKS	121
APPENDIX D - TASK/SKILL DISTRIBUTION DATA	138
APPENDIX E - TASK/SKILL DIFFICULTY ANALYSIS DATA	180
APPENDIX F - BASIC UPT TASK/SKILL DISTRIBUTION DATA	203
APPENDIX G - STANDARD TASK ANALYSIS DATA	208
APPENDIX H - SIMULATOR CAPABILITY REQUIREMENTS DATA	222
APPENDIX I - MOTION BASE SYSTEM CALCULATIONS	229
APPENDIX J - SIMULATOR CAPABILITY/TASK REQUIREMENTS DATA	233

LIST OF ILLUSTRATIONS

FIGURE		PAGE
1	TAXONOMIC DATA SYSTEM	11
2	TASK DIAGRAM OF STANDARD TASKS, ST-1 AND ST-2	23
3	POP-UP ANALYSIS DIAGRAM	37
4	TASK DIAGRAM OF THE LOW YO-YO AND COUNTER LOW YO-YO	63
5	TASK/SKILL SEGMENT OF THE POP-UP DIAGRAM	67

LIST OF TABLES

TABLE		PAGE
1	TASK/SKILL DISTRIBUTION OF REPRESENTATIVE AIR-TO-GROUND MANEUVERS	16
2	HIGH DIVE BOMB AND LOW ANGLE STRAFE AS STANDARD TASKS FOR THE DIVE TOSS, LOW DIVE BOMB, AND 30° DIVE ROCKETS DELIVERY	18
3	TASK/SKILL DISTRIBUTION OF REPRESENTATIVE AIR-TO-AIR MANEUVERS	20
4	PROJECTED STANDARD TASK PROFILE - ATTACKER	22
5	STANDARD TASK (ST-1) SKILL DISTRIBUTION	24
6	BASIC SKILLS OF STANDARD TASKS, ST-1 AND ST-2, APPLIED TO A SPECIFIED TASK GROUP	26
7	ACTUAL STANDARD TASK PROFILE - ATTACKER	27
8	TASK/SKILL DISTRIBUTION WITHIN THE LOW ANGLE POP-UP TASK	30-31
9	LOW ANGLE POP-UP TASK PROFILE	32
10	SPECIFIC CATEGORY DISTRIBUTION	33
11	POP-UP TASK/SKILL DIFFICULTY ANALYSIS	35-36
12	TASK DIFFICULTY SUMMARY OF AIR-TO-GROUND TACTICAL TASKS	34
13	UNATTACHED SKILLS COMPARISON	38
14	REPRESENTATIVE UPT FLYING TASKS	41
15	UPT TASKS HAVING SKILLS IDENTICAL AND KINDRED TO AIR-TO-AIR AND AIR-TO-GROUND TASKS	42
16	AIR-TO-AIR AND AIR-TO-GROUND TASKS HAVING SKILLS IDENTICAL AND KINDRED TO UPT SKILLS	43
17	TASK/SKILL DISTRIBUTION WITHIN THE HIGH YO-YO	45
18	TASKS CONTAINING SKILLS IDENTICAL AND KINDRED TO THE HIGH YO-YO	47
19	TASK/SKILL ACCUMULATION DATA	49
20	FINAL FLYING TASK SEQUENCE	51

continued

LIST OF TABLES

TABLE		PAGE
21	CUE REQUIREMENTS FOR AIR-TO-AIR INTERCEPT/ SINGLE TURN CONVERSION	53
22	COMPOSITE SIMULATOR REQUIREMENTS FOR TRAINING TASK, AIR-TO-AIR/SINGLE TURN CONVERSION	57-58
23	SIMULATOR DESCRIPTION	60
24	CUE WEIGHTING SYSTEM	61
25	MOTION CUEING/TIME LINE ANALYSIS OF THE POP-UP	68
26	INCREMENTAL TIME BETWEEN BASIC SKILLS AND TOTAL ELAPSED TIME FOR G, PITCH, AND ROLL	69
27	OPERATING CHARACTERISTICS OF THE FRANKLIN INSTITUTE SIX-POLE MOTION BASE	70
28	TYPICAL VALUES ASSOCIATED WITH THE SIX-POLE MOTION SYSTEM	70

PREFACE

This report represents a portion of the research program of Project 1123, United States Air Force Flying Training Division, Mr. James F. Smith, Project Scientist; Task 112302, Instructional Innovations in the United States Air Force Flying Training, Mr. Robert R. Woodruff, Task Scientist.

Credit for the initial development of this study as a contract effort belongs to Capt Jack Thorpe who is now with the Air Force Office of Scientific Research, Bolling AFB. His work in writing the statement of work and guiding the formative stages of the contract was fundamental to the success of the final product.

Dr. Edward E. Eddowes, Technical Advisor, Air Force Human Resources Laboratory, Flying Training Division, Williams Air Force Base, Arizona, provided much guidance and insight throughout this effort. His contributions were particularly valuable because of his close association with Mr. Meyer in producing a Behavioral taxonomy of undergraduate pilot training tasks and skills, a research effort upon which the present study was based.

The authors express appreciation to Lt Col Tom Rush, Chief of the 4444th OS, Luke Air Force Base, Arizona, and to Maj Kirk Ransom and Maj Dick Phillips, TAC/DOOS, for their cooperation and support in the contract effort.

An essential element for this study was obtaining interview data from aircrew personnel at the 334th and 336th OS, Seymour Johnson Air Force Base, North Carolina. The focal point for coordinating these interviews was Capt Larrie Harlan, to whom the authors are grateful.

Capt Bill Schnittger, Chief of the F-4 Instructional Systems Development Team, Luke Air Force Base, Arizona, acted as principal liaison between the Contractor/Contract Monitor and the Tactical Air Command personnel involved in this project. The authors appreciate his continuing cooperation and contributions throughout the study, without which the contract could not have been successfully completed.

Valuable information and suggestions for the project were contributed during various meetings with the Contractor by Maj J. D. Brown, Capt Dave Yates, Maj Al Lavoy, Maj Bill Mack, Capt Jim Icenhour, and Mr. Don Alford of the 4444th OS, Luke Air Force Base, Arizona, and by Lt Col Dick Lee, TAC/TAWC, Eglin Air Force Base, Florida.

INTRODUCTION

This volume presents the third and final phase of a study to develop and apply a task taxonomy for tactical flying. Applications, examples, and methodologies are presented in this volume which show how the surface task analysis and taxonomic classification system described in Volumes I and II can be used to identify, organize, and solve real-world problems related to present and future tactical flying training.

Volume I was concerned with the development of a task analysis format which would be suitable to investigate the complexities of tactical flying. The approach was to utilize the research from the Behavioral taxonomy of undergraduate pilot training tasks and skills (Meyer, Laveson, Weissman, and Eddowes) as a departure point for this effort. This earlier Undergraduate Pilot Training (UPT) research proved to be of sufficient depth so that no major modifications were required. The surface task analysis was a procedure to divide each task into sequences and each sequence into cue (C), mental action (Me), and motor action (Mo) elements.

The data base for the tactical task taxonomy was made up of seven air-to-ground and nine air-to-air maneuvers which were considered to be representative tactical flying tasks. The F-4E was chosen as the representative aircraft because of its air-to-air and air-to-ground capability. Pilots from two F-4E equipped tactical squadrons at Seymour Johnson AFB were interviewed to gain exact flying information about each of the sixteen representative tasks. These same operational pilots critiqued the analysis after completion, and changes were made so that the inputs to the surface task analysis would be as accurate as possible. This procedure was used to provide a valid data base for the taxonomy.

Volume II focused on the expansion and application of the classification rules which were used in the earlier UPT taxonomic research effort. Three of the nine classification rules were completely changed to encompass more meaningful behavioral categories, and two of the rules were modified so that they more accurately reflected the added complexity of tactical flying tasks. Although these changes and modifications took place, the nine rule UPT classification scheme remained with three rules determining behavioral characteristics for the cues category, three rules for the mental action category, and three rules for the motor action category of the surface analysis. The instructions for the application of classification rules were scrutinized and modified for greater clarity. This produced increased

consistency among researchers during taxonomic development. Comparisons of classification outcomes from rules applications accomplished independently by researchers showed an internal consistency or agreement of over 80 percent.

With the classification of the sixteen tasks completed, the taxonomic structure was evaluated based on the UPT taxonomy research. A classification matrix was again employed. However, it was expanded from an eight sub-block design to one using 24 sub-blocks, thereby increasing the matrix from 160 sorting slots to 480 slots. The increased complexity of tactical flying was thus accommodated. The classification matrix isolated 475 basic skills from the sixteen representative tasks and established 78 skill areas and 68 skill groups.

A taxonomic data system was then devised which would allow access to the taxonomy at any level of the system. The six components of the data system were indexed and cross-indexed to one another so that data could be retrieved, organized, studied, and compared to any other area within the system. The system also allowed for the simple return of the data so that this data could be used again. With the complete taxonomic data system in place, it was then possible to turn to the application of this system: the solution of tactical flying training problems.

APPLICATION OF THE TAXONOMIC DATA SYSTEM TO TACTICAL FLYING TRAINING

The taxonomic system developed in this research effort has had a user orientation from the outset. Seven application areas will be discussed in this report. These applications were derived from suggestions made by the 4444th OS team at Luke AFB. The application for the use of the taxonomy has thus been made to address real-world problems encountered by training personnel of the Tactical Air Command. The taxonomic data system has been directed toward the following application areas:

1. Informational Analysis for the Maintenance of Tactical Flying Skills
2. Informational Analysis of the Pop-Up Task
3. Air-to-Air/Air-to-Ground Task Sequencing Methodology
4. Methodology to Determine Simulator Capability Requirements
5. Methodology to Determine Motion Simulation Contributions and Limitations in Trainers
6. Methodology to Determine Simulator Usefulness in Flying Training
7. Air-to-Air/Air-to-Ground Broad Scope Analysis

Each of these application areas occupies a complete section within this report. An attempt has been made to describe the way in which the taxonomy was used so that the analyses and methodologies developed in this effort could be applied to other specific problems in a particular application area. The scope of this research has not permitted an exhaustive exploration in each application area; however, the methods developed for the taxonomy usage have been determined by researchers to be sufficient to demonstrate usefulness in each example application. It must likewise be remembered that the data base of sixteen tactical tasks, although representative, concentrated only on the basic fighter maneuvers used in tactical flying.

Review of the Taxonomic Data System - The descriptive material below presents a summary of the tactical flying task taxonomy data structure. For details about the system, the reader is referred to Volumes I and II of this technical report. This data system organized representative tactical

flying task and skill information within a taxonomy structure so that it can be used without specialized training in taxonomic development. The data system shown in Figure 1 contains the following six cross-referenced areas:

1. Classification Hierarchy - This was the basic organizational structure used in categorizing all tasks and skills within the taxonomy. It was directly related to the nine rules used to classify all tasks in the surface analysis. The hierarchy shows at what specific levels data generated by each of the nine rules can be found. A classification hierarchy diagram and the nine rules to which it is related may be found in Appendix B.

2. Classification Matrix - The classification matrix was the primary device used in sorting all flying skills into basic skill groups. It became the focal point of the taxonomy as a useful tool. The matrix was composed of 24 sub-blocks and allowed the final sorting of skills into basic skill groups with the order shown in the classification hierarchy. The original matrix was a 7 by 8 foot board which allowed a hands-on method of developing a useful system. The large board was refined into the matrix shown in Appendix B. Each matrix sub-block shows the Cues/Kind, one through four on the vertical axis, and the Motor Action/Output Values, one through five on the horizontal axis, and was consistent with the classification hierarchy. Each slot in the matrix was numbered and showed the number of skills it contained. A darkened slot contained no skills.

3. Sorting Slot Contents List - This list found in Appendix B shows the tasks and skills in coded form and established the basic skill groups contained in each slot in a matrix sub-block.

4. Task List - This list translated the task code into the task name and related directly to the surface analysis tasks. The list is found in Appendix B.

5. Card File - A skill card file was established to cross reference all skill information in the taxonomy data system. The sample card in Appendix B shows the content of the card and the translation of the coded data it contains. These skill cards are filed according to the order shown on the task list.

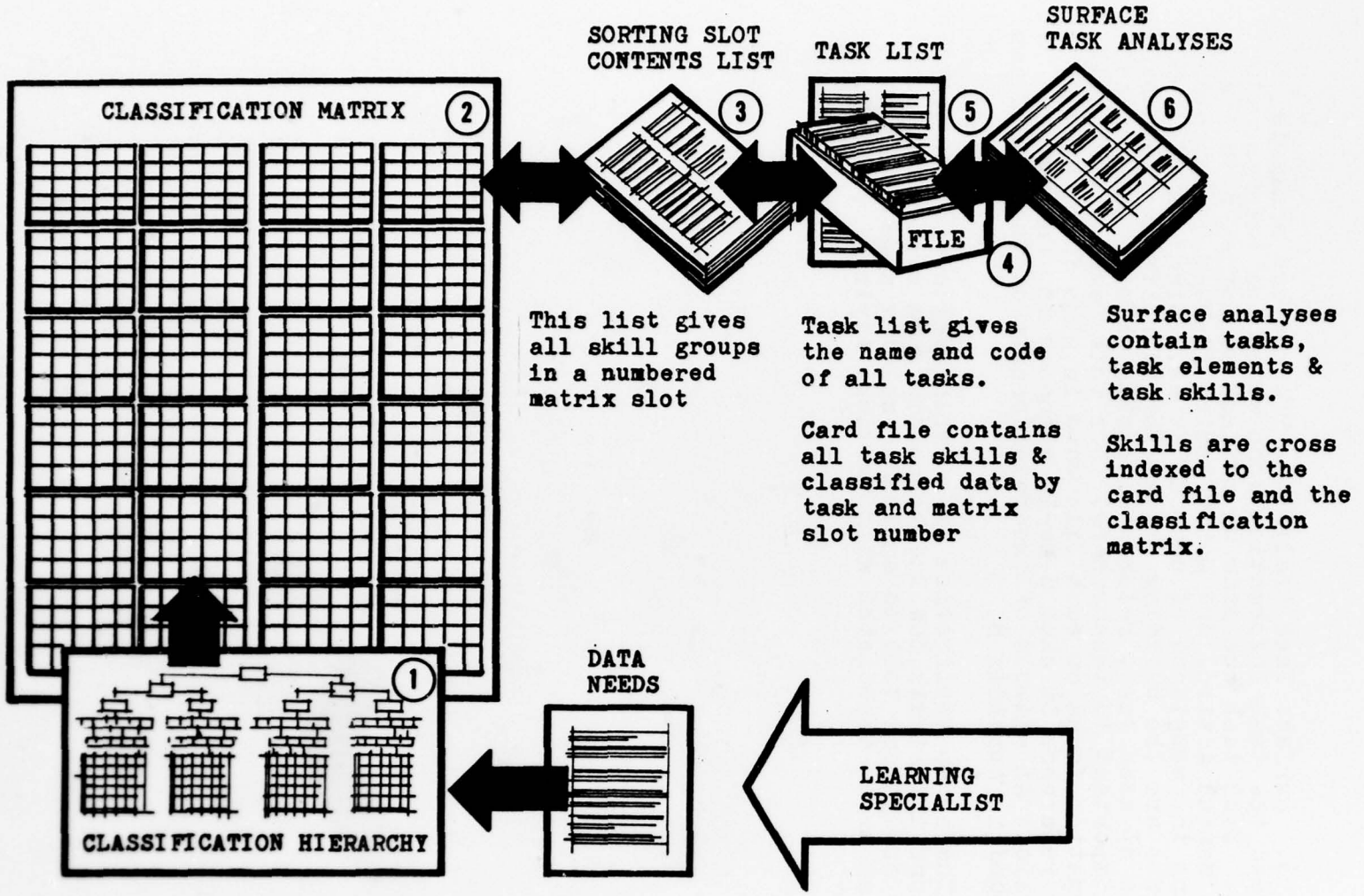


Figure 1. Taxonomic data system.

6. Surface Task Analysis - The surface analysis provided the task information upon which the taxonomy was built. Each task was made up of task sequences with the Cues, Mental Action, and Motor Action (C-Me-Mo) elements forming the substance of each sequence. Since the C-Me-Mo elements are the building blocks for identifying the basic skills of each task, reference to this information can be most important to researchers. For this reason, the skill information found on each file card is also found as a cross reference in each C-Me-Mo sequence in the surface analysis. An example of the relationship of these data can be found in Appendix B.

The seven application areas which follow in the next sections illustrate how the taxonomic data system was used as an analytical tool to assist in solving some training problem areas associated with tactical flying.

INFORMATIONAL ANALYSIS FOR THE MAINTENANCE OF TACTICAL FLYING SKILLS

Proficiency in performing varieties of mission related flying tasks occupies a high priority in Air Force training programs. Achieving such proficiencies sometimes has been regarded as the culmination of a pilot's career. It is, in fact, only the end of the beginning. After attaining competence, pilots must continue to increase and maintain their skills throughout their flying career.

The taxonomic system can be used to draw both important insights and specific data which can aid in the maintenance of flying skill proficiency. This system has been found useful in categorizing, comparing, and organizing skill data into meaningful information for the training specialist. Although the taxonomy cannot tell how skills are actually maintained, it can be used to show how both flying time and simulator time can be optimized for training. The taxonomy, by breaking tasks down into small components, suggests new training concepts and methods not previously conceived. This section explores and presents various concepts and applications of the taxonomy in the area of flying skill maintenance and retention.

Task Difficulty and Skill Maintenance - The Broad Scope Analysis of Appendix A shows how the taxonomy was used to determine an objective skill difficulty value and task difficulty index. This was done by attaching appropriate values to the behavioral element categories described by the taxonomic classification rules. With this methodology, task difficulty became a measure of basic skill intricacy exhibited by the behavioral elements within a specific task. This essentially described the difficulty level of perceptual/cognitive/motor activity involved in each skill within a given task. The task difficulty index was a functional average (mean) of this activity. The difficulty indices, derived for the representative tactical tasks analyzed in Appendix A, were subjected to a validity check. Twenty-five experienced F-4 pilots were asked to rank the maneuvers in order of estimated overall task difficulty. The survey, conducted as part of the present study, showed a reasonable agreement with the index system derived from the taxonomy. Additional research indicated that the following input areas should become part of a more complete task difficulty index:

1. Perceptual/cognitive/motor intricacy
2. Allowable deviation for each basic skill
3. Temporal proximity of one basic skill to another
4. Induced stress

5. System factors (either procedural or equipment)
6. Flying environment

The taxonomy and the approach of this research presents a methodology for the first area (perceptual/cognitive/motor intricacy) and the results of this task/skill difficulty index can be found in Appendix E. The surface analysis and accompanying task diagram can present some insight in the area of basic skill proximity as was shown in the informational analysis of the Pop-Up task discussed elsewhere in Volume III. The proximity aspect of skill difficulty, however, requires a more highly developed time line than was required for the taxonomy, and thus, skill proximity was not factored into the task difficulty data in this study. It can be observed when studying the task diagrams of the surface analyses, that otherwise moderately difficult skills could be characterized as highly difficult because they occur close together and require a close tolerance or minimum allowable deviation factor. Another area which must be considered is induced stress. In this research, induced stress was considered to be a combination of basic skill intricacy, close temporal skill proximity, close tolerances, adverse system factors, and environmental factors. It was not within the scope of this research to attach values to each of these difficulty areas; however, they must be considered as having a great impact on skill difficulty and maintenance of total flying skill proficiency.

The Task/Skill Distribution Analysis as an Adjunct to Skill Maintenance - This methodology also is described in the Broad Scope Analysis of Appendix A. The complete task/skill distribution found in Appendix D compared the basic skills of one task with the skills of all other tasks within a given data base. The distribution allowed researchers to determine which basic skill behaviors within one task were identical or kindred to skills in any other task.

It was determined that this methodology could be used to develop a standard training task whose basic skills would be highly representative of a number of other flying tasks. A standard task, if properly tested and implemented, could reduce training time requirements through generalized skills acquisition. Since the task/skill distributions contained numerical comparisons, a properly organized analysis could determine in advance the percent effectiveness of the standard task on a specified group of tasks. Although a standard training task would not be a complete substitute for individually trained tasks, it could reduce by a specifiable amount the flying activity needed to maintain proficiency of the task group. Standard task methodology

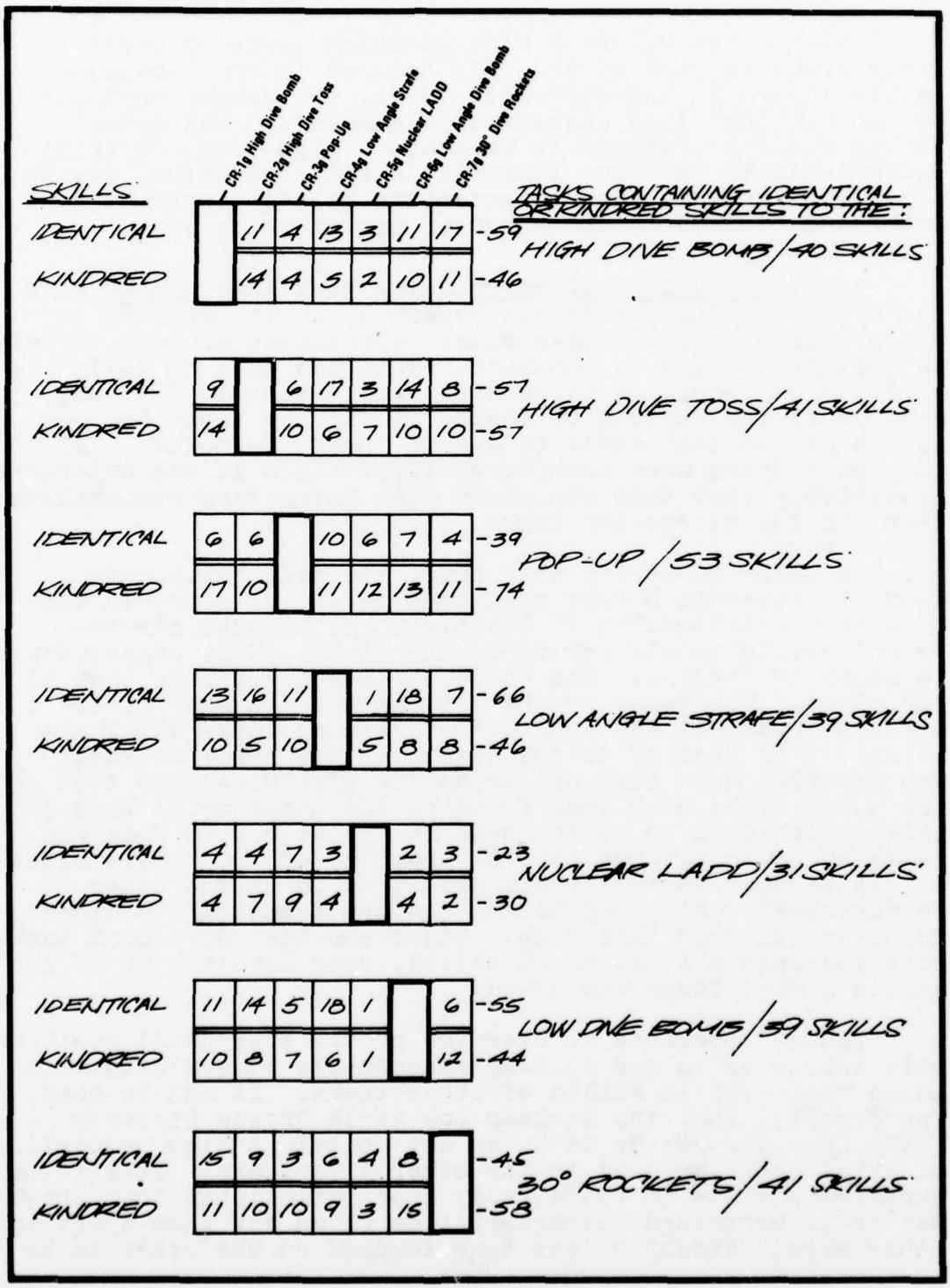
could also point out more clearly which tasks or parts of tasks would be most effectively trained in the simulator before flying in the aircraft. Thus, the proper application of the standard task concept with simulation and actual flying could be refined to maintain a high level of skill proficiency in tactical tasks while reducing actual flying time...and perhaps even heighten the pilots' interest by increased efficiency and a better use of their time.

Air-to-Ground Standard Training Task Development - At the outset of this taxonomic research, it was decided to build a data base of tasks which represented as much variety in tactical flying as possible. This was done to fully employ the capacities of analysis and taxonomic systems. Because of the variety of tasks, it was not known how the skills of one task would relate to those of another. Air-to-ground tasks were considered first since it was determined intuitively that they contained more inter-task commonality than did the air-to-air tasks.

In order to verify this idea, the task/skill data found in Appendix D were organized to show a complete distribution relationship of identical and kindred air-to-ground skills to all air-to-ground tasks. This organization is shown in Table 1. The table shows the specific task at the right. The boxes to the left show the number of basic skills across all the other air-to-ground tasks which are identical or kindred to the skills of the specific task. For example, note that skills of the High Dive Bomb task at the upper right have been found by the taxonomy to have 11 skills identical to those found in the High Dive Toss and 14 found to be kindred skills. Looking at the entire block, it can be seen that 59 basic skills found in the other representative air-to-ground tasks are identical to those found in the High Dive Bomb. Since the High Dive Bomb task contains only a total of 40 skills, some doubling up of the skills across tasks was noted.

Table 1 presents an overview of the task/skill relationship across tasks and allowed researchers to evaluate which tasks were rich in skills of other tasks. It can be seen, for example, that the Nuclear Low Angle Drogue Delivery (LADD) and the Pop-Up tasks do not contain a high proportion of skill behavior used in the other five tasks. This is not surprising since it had already been established that these two tasks contained characteristics which set them apart in other ways. Attention was thus focused on the other tasks

Table 1. Task/Skill Distribution
of Representative Air-to-Ground Maneuvers



having more obvious similarities in an attempt to determine a standard training task for them. It can be seen by studying the totals of identical and kindred skills at the right of each box that the High Dive Bomb and Low Angle Strafe tasks would make good candidate standard tasks. Skill data from both tasks were tallied and organized. It was determined that the basic skills of both tasks were present in sufficient number and that the proficiency in both tasks should also have carry-over proficiency to the Dive Toss, Low Dive Bomb, and 30° Dive Rocket Delivery tasks. Table 2 shows the results of this organization.

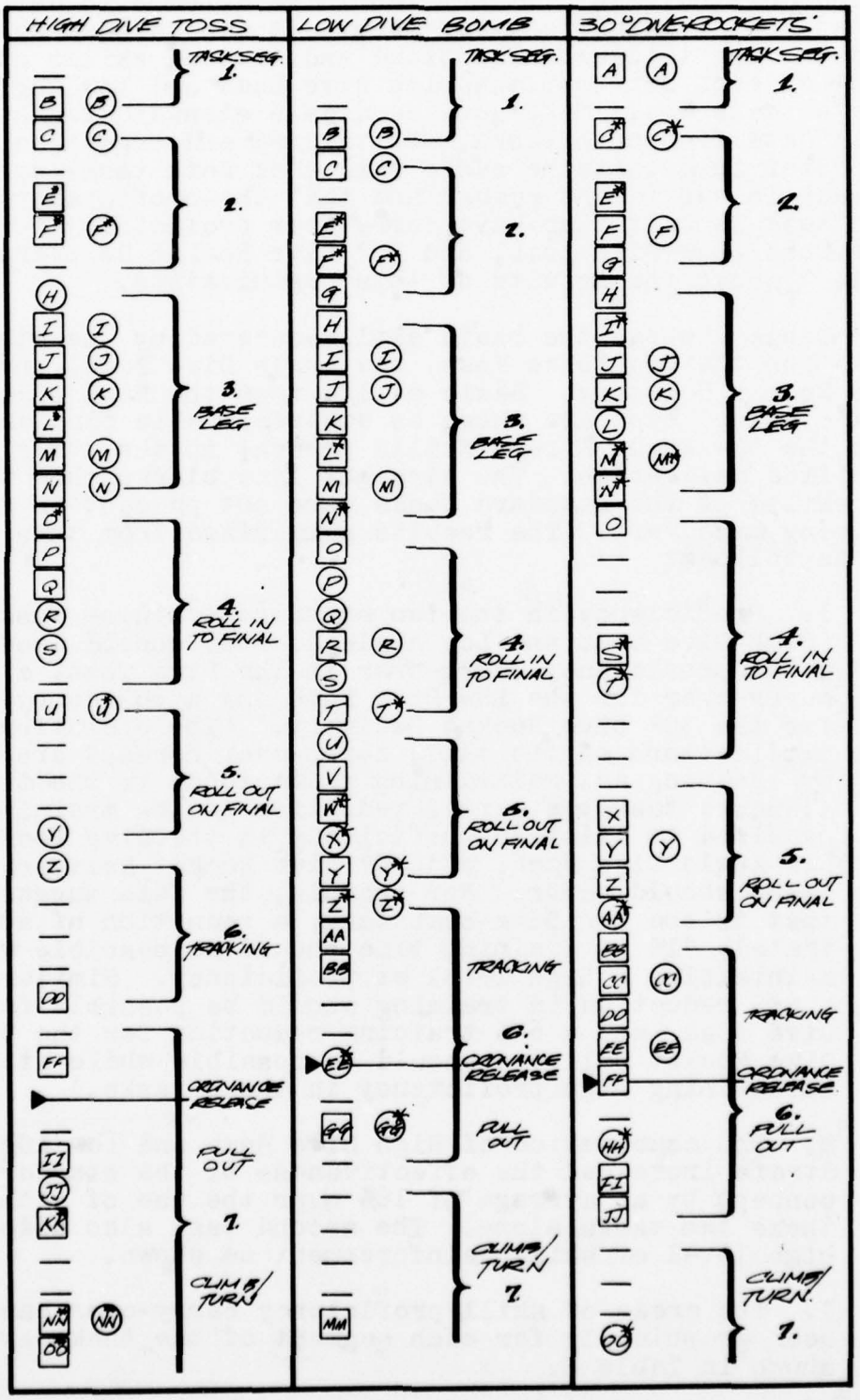
Table 2 shows the basic skills covered by the standard tasks for the High Dive Toss, Low Angle Dive Bomb, and 30° Dive Rocket Delivery. Basic skills from the High Dive Bomb as a standard task are shown as squares, while circles show the Low Angle Strafe skills present in the three specified deliveries. The straight line blanks show where the skills of the standard tasks were not present in the delivery maneuvers. The results summarized from this table are as follows:

1. Proficiency in the two standard training tasks (High Dive Bomb and Low Angle Strafe) should lead to a 63% proficiency carry-over in the Dive Toss, a 71% carry-over for the Low Dive Bomb and a 68% carry-over for the 30° Dive Rocket Delivery. (The operational implications of the skill carry-over concept are that by training and maintaining proficiency in the two standard tasks, a marked reduction in the training required to maintain proficiency in the Dive Toss, Low Angle Dive Bomb, and 30° Dive Rocket Delivery tasks should occur. For example, the data suggest that in the Low Dive Bomb task, a reduction of approximately 71% in training time should be possible while maintaining a high level of proficiency. Similarly, a 63% reduction in training should be possible for the Dive Toss, and a 68% training reduction for the 30° Dive Rocket Delivery should be possible while still maintaining high proficiency in these tasks.)

2. The combination of High Dive Bomb and Low Angle Strafe increased the effectiveness of the standard task concept by an average of 16% over the use of either of these two tasks alone. The second task also added a high level of skill reinforcement as shown.

3. The areas of skill proficiency carry-over can be seen graphically for each segment of the tasks as shown in Table 2.

Table 2. High Dive Bomb and Low Angle Strafe as Standard Tasks for the Dive Toss, Low Dive Bomb, and 30° Dive Rockets Delivery



4. The differences and similarities between the three specified deliveries can be seen by noting the number of blank lines during the tracking segment of each task prior to the weapons release, shown by a black arrow in each column.

The High Dive Bomb and the Low Angle Strafe maneuvers were considered satisfactory standard training tasks for the High Dive Toss, Low Dive Bomb, and 30° Dive Rocket deliveries because they contained at least 50 percent of the basic skills for these specified tasks. It should be pointed out that the information presented in Table 2, though accurate, has been simplified. It does not show a complete listing of skills which double up on a skill area. This was particularly true of the kindred skills which were not shown unless they filled a space where no identical skill existed. These were not shown for the sake of clarity; however, their existence greatly adds to the skill reinforcement in a number of task segments in each of the three delivery tasks trained by the standard tasks.

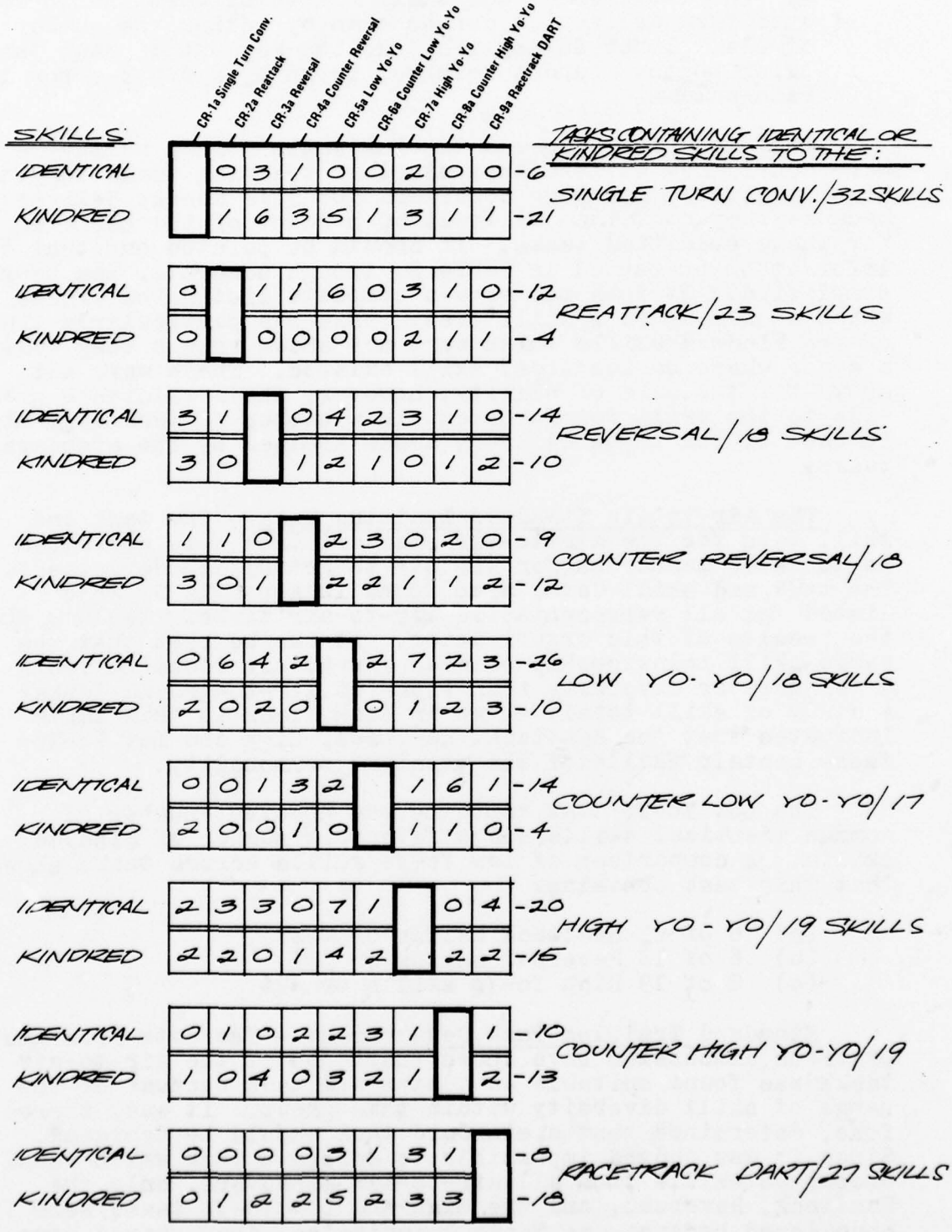
The Air-to-Air Standard Training Task - The task and skill data for the air-to-air standard task were organized in the same manner as for the air-to-ground standard tasks. The task and skill data, also found in Appendix D, were listed for all representative air-to-air tasks. Table 3 shows the results of this organization. It can be seen that the basic skill relationship between air-to-air tasks reflects a far greater diversity than those of air-to-ground tasks. A study of skill totals shown in each block in this table indicates that the Reattack, Reversal, High and Low Yo-Yo tasks contain skills of the greatest commonality.

The Low Yo-Yo task contains the greatest number of common identical skills and a favorable number of kindred skills. A comparison of Low Yo-Yo skills across tasks shows that this task contains:

(a) 6 of 23 Reattack skills or 26%
(b) 6 of 18 Reversal skills or 33%
(c) 8 of 19 High Yo-Yo skills or 42%

Standard Training Task Development - The data from the previous discussion have shown that none of the air-to-air tasks was found suitable as a standard task because of the range of skill diversity within this group. It was, therefore, determined that a standard task should be designed. Since it was judged impossible to design a task which would encompass skills from all air-to-air maneuvers, only the Reattack, Reversal, and the High and Low Yo-Yo tasks were considered because, as Table 3 indicates, they shared some commonality of skills.

Table 3. Task/Skill Distribution of Representative Air-to-Air Maneuvers



The Standard Task Profile - These four maneuvers were appraised for general behavioral properties. This was accomplished by using the profiles found in Appendix C. Five categories were considered to be of particular significance. These were the effector output, continuity, information and decision processing, and major cues. Data for each category were tallied and an average derived for each area. The information listed in Table 4 shows a projected profile of a standard task for the Attacker. Particular attention was given to the effector output since these data represent the positioning of the aircraft in three-dimensional space. The remaining data on the profile list provided valuable insight into other behavioral qualities required of the standard task. The projected profile of requirements became the standard against which the actual standard task as designed could be evaluated.

It was also necessary to study the task segments of the four specified maneuvers to determine the most essential basic skills. This was done by looking at the maneuver diagrams and comparing the specific skill points on the diagrams with the corresponding task sequences of the surface analysis. At this point it was noted that the standard task should maintain the same Attacker/Defender format as existed in the surface analysis and, in fact, as exists in the real world. It was realized, however, that no previous experience existed among researchers to accomplish this requirement. It was determined that the taxonomy could offer no further guidance, and candidate standard tasks would have to be designed intuitively. Numerous sketch diagrams were made and specific action points designated. The diagrams which appeared to have the greatest potential were analyzed and classified, using the taxonomic system. This approach yielded the Attacker/Defender Standard Task shown in Figure 2. The surface analyses of these two tasks, designated St-1 (Attacker) and St-2 (Defender), can be found in Appendix G.

These surface analyses were then classified in order to extract the behavioral characteristics within each task sequence. These data were classified, entered on notation cards, and sorted into skill groups on the matrix board.

Now, researchers could determine if the standard tasks contained the same skills as the specified maneuvers they were designed to emulate. The results of this step can be seen in Table 5 which shows the task/skill distribution of Standard Task, St-1. This task contained sixteen skills and these are noted in the left-hand column of the table along with the slot numbers of the classification matrix

Table 4. Projected Standard Task Profile - Attacker

A. Average Effector Output

1. Ai | Ru | St - 37%

2. {Ai / Ru} | St - 33%

3. Ai | St - 13%

4. {Ai / Ru / St} - 6%

5. St - 5%

6. {Ai / Ru} | {St / Th} - 3%

Legend:

Ai - Aileron
Ru - Rudder
St - Stabilator
Th - Throttle

| - Performed Successively

{ - Performed Coordinated

B. Average Continuity

Establish Attitude - 38%

Establish Rate of Attitude Change - 49%

C. Information Processing

Multi-Cue - 71%

Multi-Cue (Iterative) - 12%

Memory Recall (Iterative) - 10%

Specific Cue - 5%

D. Decision Processing

Simple Processing - 8%

Complex Processing - 92%

E. Cues Combinations

VACM - 85%

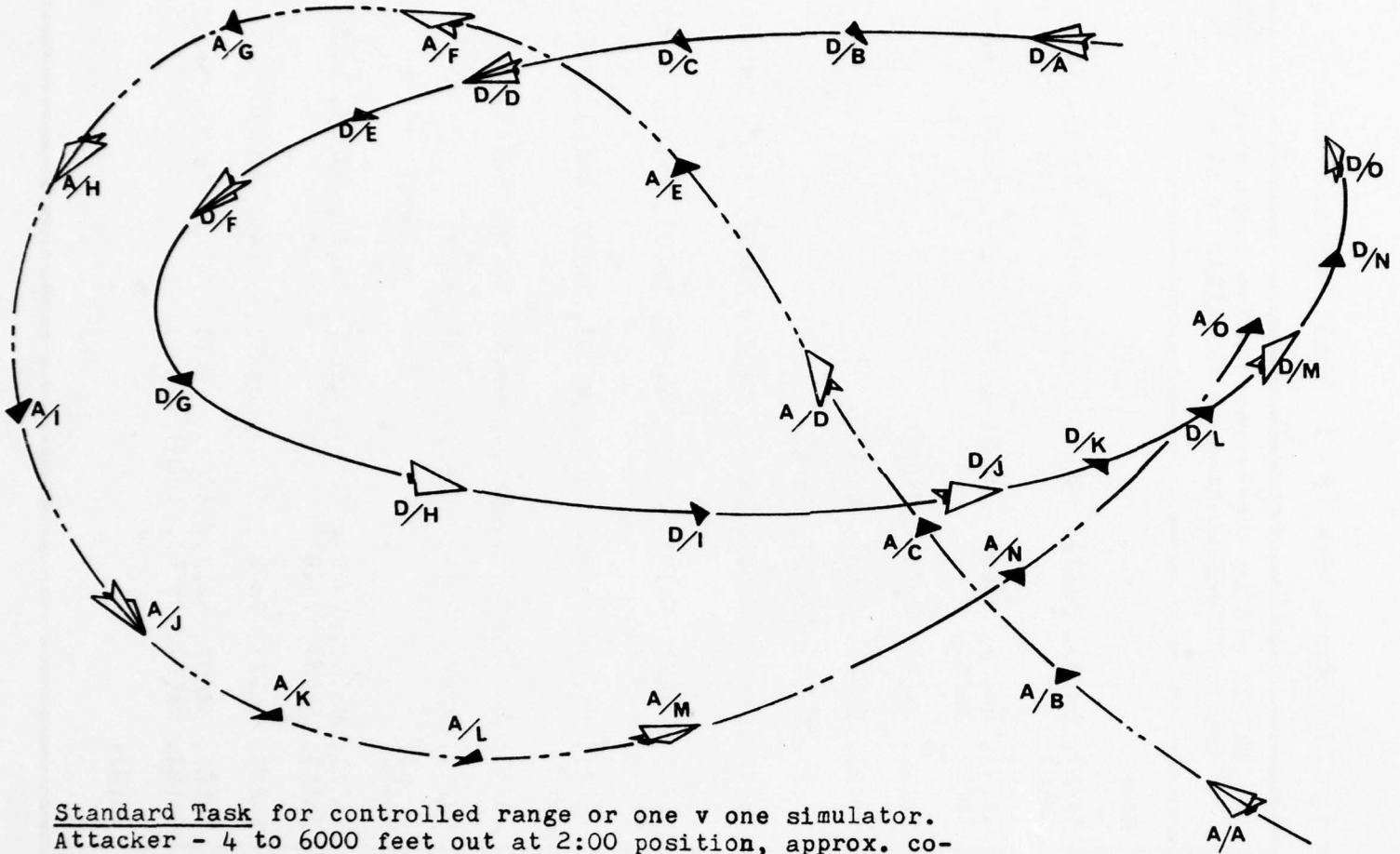
VAC - 7%

VCM - 5%

VC - 3%

Legend:

V - Visual, A - Aural, C - Control, M - Motion



Standard Task for controlled range or one v one simulator. Attacker - 4 to 6000 feet out at 2:00 position, approx. co-airspeed and altitude, missile shot, converting to a tracking gun shot - like aircraft.

Figure 2. Task diagram of standard tasks, St-1 and St-2.

Table 5. Standard Task (St-1) Skill Distribution

Skill Slot	Skills within the Representative Tasks which are Identical or Kindred to Skills of St - 1
A - 292	None
B - 337	5a(K), 1g(W), 3g(S), 6g(T), 8a(K), 9a(M), 5a(F), 7a(G) 4a(O)
C - 280	1a(V), 4a(P), 6a(G), 1a(R), 2a(U), 3a(J), 5a(G), 5a(C) 5a(L), 5a(N)
D - 279	7a(E), 2a(I), 2a(K), 7a(L)
E - 280	4a(H), 6a(H), 6a(M), 8a(I)
F - 279	7a(E), 2a(I), 2a(K), 7a(L)
G - 280	2a(J), 2a(L), 2a(N), 2a(U), 3a(J), 5a(C),5a(L), 1a(R) 1a(V), 4a(P)
H - 280	5a(H), 8a(H), 5a(D), 2a(M), 4a(G), 5a(O), 6a(N), 1a(M) 9a(AA), 7a(N)
I - 280	5a(H), 8a(H), 5a(D), 2a(M), 4a(G), 2a(J), 2a(L), 2a(N) 1a(R)
J - 280	7a(N), 7a(C), 9a(Y), 5a(O), 6a(N), 7a(M), 9a(AA)
K - 277	9a(V), 9a(F), 9a(X), 5a(I), 3a(G), 8a(N)
L - 317	7a(U)
M - 277	5a(I), 9a(Z), 7a(R), 2a(F), 2a(G), 3a(G), 8a(N), 1a(D) 3a(L), 3a(M), 7a(Q)
N - 277	9a(F), 9a(V), 9a(Z), 3a(G), 8a(N), 9a(X), 5a(I)
O - 277	9a(Z), 3a(G), 8a(N), 8a(D), 5a(I), 7a(R), 9a(X), 9a(V) 9a(E), 1a(D), 3a(L), 3a(M), 7a(Q)
P - 277	9a(X)

into which they had fallen. The skills to the right in this table are those which are identical or kindred to the skills of the Standard Task, St-1. It can be seen, for example, that skill "H" of this standard task is the same as skill 5a (O) or the "O" skill within the Low Yo-Yo. Reference to the task list shown in Appendix B gives the task names and their code designators. A similar task/skill distribution was made for the Defender's Standard Task, St-2, and can be found in Appendix G. The skill data in Table 5 were tallied into task groups to see if skills from the standard tasks clustered into the specified maneuvers. Table 6 shows the skills within each specified maneuver at the left of each column and the black triangles indicate which skills have been covered by the standard tasks. The blank lines indicate that no standard task skills exist for a skill in that maneuver. For example, standard task skills exist for skills: C, F, G, I, J, K, M, N, and U of the Reattack maneuver. The following is a percentage breakdown of standard task skills within the specified maneuvers:

1. Reattack: 9 of 23 skills or 40%
2. High Yo-Yo: 13 of 19 skills or 68%
3. Low Yo-Yo: 12 of 18 skills or 66%
4. Counter High Yo-Yo: 6 of 19 skills or 31%
5. Counter Low Yo-Yo: 4 of 18 skills or 22%

The results of this list show that the standard tasks have acceptable skill carry-over for the High and Low Yo-Yo specified maneuvers. The standard tasks show a 40% skill carry-over to the Reattack which makes it moderately successful for that maneuver. The counter maneuvers showed a disappointing percentage of carry-over skills particularly since all the task diagrams appear to be the same.

A final check of the Standard Task, St-1, profile was made. This task profile shown in Table 7 can be compared to the projected profile which was developed prior to the generation of the standard task(s). Examination of the projected and actual profiles show that an acceptable level of basic behavioral characteristics has been achieved in the St-1, Standard Task.

Conclusion - The taxonomy has made it possible to examine and compare the behavioral characteristics of basic skills of one task with those of another. This capability presents the learning specialist with the unique opportunity of quantifying and predicting the learning impact of one task or set of tasks upon other tasks. The task/skill distribution analysis has been shown to be an important adjunct to understanding how and where skills learned in

Table 6. Basic Skills of Standard Tasks, St-1 and St-2, Applied to a Specified Task Group

Reattack	High Yo-Yo	Low Yo-Yo	Counter High Yo-Yo	Counter Low Yo-Yo
A ——	A ——	A ——	A ——	A ——
B ——	B ——	B ——	B ——	B ——
C ▲	C ▲	C ▲	C ——	C ——
D ——	D ▲	D ——	D ▲	D ——
E ——	E ——	E ▲	E ——	E ——
F ▲	F ▲	F ——	F ——	F ——
G ▲	G ▲	G ▲	G ——	G ▲
H ——	H ▲	H ▲	H ▲	H ▲
I ▲	I ▲	I ▲	I ▲	I ——
J ▲	J ▲	J ▲	J ——	J ——
K ▲	K ▲	K ▲	K ▲	K ——
L ——	L ▲	L ▲	L ▲	L ▲
M ▲	M ▲	M ▲	M ▲	M ▲
N ▲	N ▲	N ▲	N ——	N ——
O ——	O ▲	O ——	O ——	O ——
P ——	P ——	P ——	P ——	P ——
Q ——	Q ——	Q ▲	Q ——	Q ——
R ——	R ——	R ▲	R ——	
S ——	S ——		S	
T ——				
U ▲				
V ——				
W ——				

▲ - Indicates skills from St-1 and St-2

Table 7. Actual Standard Task Profile - Attacker

A. Average Effector Output

1. Ai | Ru | St - 37%

2. {Ai, Ru | St} - 31%

3. {Ai, Ru, St} - 18%

4. Ai | St - 6%

5. Ai | St | Th - 6%

Legend:

Ai - Aileron
Ru - Rudder
St - Stabilator
Th - Throttle

| - Performed Successively

{ - Performed Coordinated

B. Average Continuity

Establish Attitude - 13%

Establish Rate of Attitude Change - 87%

C. Information Processing

Multi-Cue - 80%

Multi-Cue (Iterative) - 12%

Memory Recall (Iterative) - 6%

D. Decision Processing

Simple Processing - 0%

Complex Processing - 100%

E. Cues Combinations

VACM - 94%

VAC - 6%

Legend:

V - Visual, A - Aural, C - Control, M - Motion

one task can be expected to transfer to other tasks. The Standard Task development has shown, in practical terms, how this transfer, or carry-over process, functions in both air-to-ground and air-to-air tasks. The air-to-ground analysis showed that there is substantial commonality among air-to-ground tasks. Examination of the task/skill distributions for air-to-ground tasks shows that the skills of these tasks are highly interrelated. Thus, it was not surprising that standard tasks could be identified within the existing pool of air-to-ground maneuvers. By contrast, the air-to-air maneuvers have been found to contain skills which, although related to other air-to-air tasks, are also almost equally related to the skills of the air-to-ground maneuvers group. This perhaps comes as no surprise to the average fighter pilot. Interview data from this research indicated that pilots may be intuitively aware of this skill relationship. The standard task developed for several air-to-air maneuvers has shown that skill learning carry-over can be made to occur when the essences of several maneuvers are designed into a single standard task. The skill maintenance possibilities of the standard tasks can be explored and developed through the use of the taxonomy. Applied as a sorting tool, it can be used to determine where and to what degree a standard task, or indeed any new training task, can be expected to succeed before it is tried. Taxonomic data cannot show how such a new training task should look, except in broad generalities; however, this aspect is perhaps not as important as being able to determine, with a reasonable degree of accuracy, how successful one new training task will be in relation to another. The work in this section demonstrates that the skills of new candidate training tasks can be analyzed using the taxonomic system to determine the probability of their successful application. This last aspect alone should reduce the subjective discussion which has generally prevailed among training personnel responsible for the maintenance of flying skill proficiency.

INFORMATIONAL ANALYSIS OF THE POP-UP TASK

The Low Angle Pop-Up air-to-ground delivery was chosen for analysis because of the critical nature of this task as a training problem. Pilot interview data acquired for the preparation of the surface task analysis centered around the performance of the Pop-Up maneuver in a controlled range environment. This was done so that the situation would be consistent with the other six air-to-ground tasks in the taxonomy data base.

The surface analysis isolated 53 basic skills from the downwind position through the actual Pop-Up delivery and off target pull-up. The entire taxonomic system was used to organize and compare skill information in analyzing this air-to-ground task.

Data Acquisition - Seven data areas were determined to be meaningful for the analysis of the Pop-Up task.

1. Task/Skill Distribution Within the Pop-Up Task - All skills and skill groups across all the representative air-to-air and air-to-ground tasks in the taxonomy were referenced to each skill in the Low Angle Pop-Up delivery. This was done by noting the slot numbers at the top right of each skill card in the taxonomy data system file. Each slot was then referenced to the sorting slot contents list which showed each skill or skill grouping within a matrix sorting slot. The results of this data acquisition are presented in Table 8. It should be noted that the starred slot numbers indicate where skills within the Pop-Up are not identical to any other skills in the representative flying tasks. A total of 23 out of 53 skills, or 43%, were such apparently unrelated or unattached skills. Examination of the most critical segment of the task from skill Z through UU showed that 9 of these 22 skills, or 41%, were also unattached or not identical to any other skills in the taxonomy data base comprising the sixteen air-to-air and air-to-ground tasks. The distribution analysis also showed that the number of air-to-air skills grouped in the Pop-Up from the pop point through the delivery portion of the task was 32 percent.

2. Behavioral Categories Analysis - A task profile was developed using data from the taxonomic classification system. Specific quantitative information was tabulated and grouped for each of the behavioral categories of the taxonomy. Table 9 shows a profile of the Low Angle Pop-Up task. A comparison analysis was made between the Pop-Up profile and the profiles of all the other representative tasks. This analysis showed that the categories of the

Table 8. Task/Skill Distribution Within the Low Angle Pop-Up Task (continued)

Skill	Slot No.	Tasks in Skill Groups
A%	47	No other skills
B%	247	No other skills
C%	332	No other skills
D%	270	No other skills
E	280	Cr-5g(N)
F	260	Cr-1g(S) Cr-4g(S) Cr-6g(R)
G%	132	No other skills
H	332	Cr-2g(Z) Cr-2g(KK) Cr-3g(PP) Cr-7g(C)
I	275	Cr-5g(Q) Cr-6g(D)
J	275	Cr-5g(P) Cr-7g(U) Cr-1a(CC)
K	257	Cr-3a(I) Cr-3a(N)
L	252	Cr-1g(N) Cr-2g(N) Cr-5g(V)
M%	287	No other skills
N	327	Cr-8a(B) Cr3g(N)
O%	269	No other skills
P	275	Cr-6g(JJ)
Q%	20	No other skills
R%	372	No other skills
S	337	Cr-5a(K) Cr-1g(W) Cr-6g(T)
T%	200	No other skills
U	280	Cr-1a(R) Cr-2g(V)
V%	17	No other skills
W	280	Cr-3a(F)
X%	257	No other skills
Y%	217	No other skills
Z%	377	No other skills

Table 8. Task/Skill Distribution Within the Low Angle Pop-Up Task (concluded)

Skill	Slot No.	Tasks in Skill Groups
POP POINT TO ORDNANCE DELIVERY	Z*...377	No other skills
	AA*...277	No other skills
	BB....276	Cr-3g(KK)* Cr-5g(I)
	CC.....16	Cr-1a(K)
	DD*...217	No other skills
	EE*...217	No other skills
	FF....337	Cr-4a(O) Cr-4g(II)
	GG....280	Cr-5g(BB)
	HH....280	Cr-5a(O) Cr-6a(N) Cr-7a(M) Cr-9a(AA)Cr-5G(CC
	II....277	Cr-1a(Z) Cr-3a(K)
	JJ....257	Cr-3a(P) Cr-6g(W) Cr-6g(BB)
	KK....276	Cr-3g(BB)*Cr-5g(Z)
	LL....280	Cr-6a(G)
	MM....277	Cr-1a(D) Cr-3a(L) Cr-3a(M) Cr-7a(O)Cr-6g(Z)
	NN*....17	No other skills
	OO*...257	No other skills
	PP....332	Cr-2g(Z) Cr-2g(KK) Cr-3g(H)* Cr-7g(C)
	QQ*...252	No other skills
	RR*...252	No other skills
	SS....292	Cr-3a(O)
	TT*...271	No other skills
	UU....277	Cr-2g(JJ) Cr-4g(GG)
VV*.....256		No other skills
WW.....332		Cr-1a(B) Cr-1g(BB) Cr-5g(W) Cr-6g(O)
XX.....275		Cr-1g(I) Cr-2g(I) Cr-3g(YY) Cr-4g(I) Cr-4g(JJ) Cr-4g(KK) Cr-6g(I)
YY.....275		Cr-1g(I) Cr-2g(I) Cr-3g(XX)* Cr-4g(I) Cr-4g(JJ) Cr-4g(KK) Cr-6G(I)
ZZ.....15		Cr-7g(NN)
AAA.....12		Cr-4g(MM)

Table 9. Low Angle Pop-Up Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
		freq.			freq.		
V 0	1-C 0	25 4 30 2 35 8 40 11 45 8 50 14 55 3 60 3	MC 36	CP 41	35 1 40 1 45 1 50 4 60 2 70 5 80 9 90 3 100 8 110 2 120 1 125 1 175 2 200 1 225 4 250 5 275 1 300 2	Ai - 14 St → Ai Ru Th-1 St Ai Ru St-13 → Ai Ru St Tr - 1 Ai Ru - 8 St → Th Tr - 1 St St - 6 → Th - 1 Ai Ru St Th - 2 St Ai Ru St-2 Th → Ai Ru St Tr - 2 St Ai Ru - 1 St	V-1 5
VA 0 VC 6 VM 0	2-C 6		MC(I) 3	SP 12			V-2 31
VAC 6 VAM 0 VCM 11	3-C 17		MR(I) 8	CONT.			V-3 0
			SC 1	A 32			V-4 1
VACM 30	4-C 30		SC(I) 3	R 21			V-5 16
		aver. 43	I 2		aver. 125		

air-to-air tasks fell into rather close numerical ranges peculiar to a specific category. This grouping of ranges was also true for six of the seven air-to-ground tasks. The exception was the Pop-Up. Essentially, the Cues Kind and Quantity, Input Index, and Information Processing categories fell into ranges characteristic of the air-to-air tasks. Conversely, Decision Processing, Continuity, Output Index, and Motor Output categories fell into ranges characteristic of the air-to-ground tasks. The Input Index average of the Pop-Up was unique in that it was the second highest of all the air-to-air tasks and the Input/Output Index average was likewise unique because it was the lowest of all air-to-ground tasks. The Motor Output showed average air-to-ground effector output combinations, but it also contained the greatest variety of effector outputs. This information, though general in nature, indicated that this task had about as many air-to-air as air-to-ground behavioral characteristics.

3. Distribution of Specific Behavioral Categories - Three categories were chosen for closer analysis from the pop point (Z) through the ordnance delivery (UU). Decision Processing, Continuity, and Effector Output combinations were chosen because they were related to piloting requirements to place the aircraft in the desired position in space to achieve the proper results. The grouping of taxonomic data in Table 10 shows the range and concentration of these behavioral elements within the actual pop-up portion of the task. Of specific interest were the circled skills, which were found to be unrelated to others in the data base, and the asterisked skills, which can be found in other air-to-air tasks.

Table 10. Specific Category Distribution

Task Number.....	(Z)	(AA)	BB	CC*	(DD)	(EE)	FF*	GG	HH*	II	JJ*
Decision Processing.....	CP	CP	CP	SC	SC	SC	CP	CP	CP	CP	CP
Continuity.....	A	R	R	A	A	A	A	R	R	R	A
Effector Output.....	/Ai St	St	St	St	/Ai St	/Ai St	/Ai St	{Ai Ru St	{Ai Ru St	{Ai Ru St	/Ai Ru St

Task Number.....	KK	LL*	MM*	(NN)	(OO)	PP	(QQ)	(RR)	SS*	(TT)	UU
Decision Processing.....	CP	CP	CP	SC	CP	CP	CP	CP	CP	CP	CP
Continuity.....	R	R	R	A	A	A	A	A	A	R	R
Effector Output.....	St	{Ai Ru St	/Ai Ru St	/Ai Ru St	/Th Tr St	/Ai St	/Ai Ru St	/Th Ai St Ru	/Ai St Ru	St	/St Th

4. Task//Skill Difficulty Analysis - This analysis was based on information contained in each of the nine behavioral categories in the classification system of the taxonomy. Rules were developed so that various skill components in the various categories could be assigned numeric values. These rules and their rationale can be found in Appendix A. Table 11 shows task//skill difficulty analysis for the Low Angle Pop-Up maneuver. Table 12 shows the ranking of the seven representative air-to-ground tasks based on the results of the task//difficulty index. The tasks were ranked from most difficult to least difficult. It can be seen that the numerical spread in difficulty, as seen by the index, was 4.7 points which indicated that difficulty level had clustered very closely. This was expected due to the basic similarity of air-to-ground tasks on a controlled range. Contrary to researchers' beliefs, however, was the fact that the Pop-Up task ranked among the less difficult of all air-to-ground tasks in the data base. This information suggested that perhaps factors other than basic skill difficulty as defined in Appendix A accounted for the criticality of this maneuver as a training problem.

Table 12. Task Difficulty Summary of Air-to-Ground Tactical Tasks

Task No.	Task Name	Difficulty Index
CR-6g	Low Angle Dive Bomb	61.1
CR-2g	High Dive Toss	61.1
CR-1g	High Dive Bomb	60.0
CR-4g	Low Angle Strafe	59.8
CR-7g	30° Dive Rockets	59.7
CR-3g	Low Angle Pop-Up	58.9
CR-5g	Nuclear LADD	56.4

5. Task Diagram Analysis - The task diagram was done in conjunction with the development of the surface task analysis. This was included so that researchers and those who would later use the analysis might have a clearer mental concept of what was occurring at each point described in the analysis. All data gained from the taxonomy to this point showed that the Low Angle Pop-Up contained many air-to-air characteristics, particularly in the critical pre-delivery portion of the task. Figure 3 shows the position and attitude of the aircraft during the 22 skills from the pop point through ordnance delivery. In addition, the ground track with relative distance, airspeed, and altitude is also shown together with informational calls from the

Table 11. Task/Skill Difficulty Analysis for
Low Angle Pop-Up Task Difficulty Index: 58.97
Skill Value Range: 41.5-74.6

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5.	5.	8.3	6	7	4	4	46.3
B	7	5.	2.5	10.	10	7	4	4	49.5
C	9	7.5	2.5	6.7	10	7	4	4	50.7
D	7	5.	1.6	10.	10	10	8	10	61.6
E	10	10.	6.6	10.	10	10	8	10	74.6
F	10	10.	5.8	10.	10	7	6	10	68.8
G	8	7.5	3.3	1.7	6	7	4	4	41.5
H	8	7.5	4.2	6.7	10	7	4	4	51.4
I	7	7.5	4.2	10.	10	10	6	10	64.7
J	8	7.5	5.	10.	10	10	6	10	66.5
K	10	10.	5.8	10.	10	7	6	4	62.8
L	8	7.5	5.	10.	10	7	4	4	55.5
M	7	5.	1.6	8.3	10	7	4	4	46.9
N	7	5.	1.6	6.7	10	7	4	4	45.3
O	7	5.	1.6	10.	10	10	6	8	57.6
P	8	7.5	5.	10.	10	10	8	10	68.5
Q	10	10.	7.5	10.	6	7	6	10	66.5
R	8	7.5	4.2	1.7	10	7	4	4	46.4
S	10	10.	5.8	6.7	10	7	4	4	57.5
T	10	10.	5.8	5.	6	10	6	10	62.8
U	10	10.	5.	10.	10	10	6	10	71.0
V	10	10.	5.8	10.	6	7	6	4	58.8
W	10	10.	3.3	10.	10	10	8	10	71.3
X	10	10.	5.8.	10.	10	7	8	4	64.8
Y	10	10.	5.8	1.7	6	7	4	4	48.5
Z	10	10.	4.2	1.7	10	7	4	4	50.9
AA	10	10.	4.2	10.	10	10	4	4	62.2
BB	10	10.	5.8	10.	10	10	2	2	59.8
CC	10	10.	3.3	10.	6	7	2	2	50.3
DD	10	10.	5.	3.3	6	7	4	4	49.3
EE	10	10.	3.3	3.3	6	7	4	4	47.6

Table 11. Pop-Up Task/Skill Difficulty Analysis
(concluded)

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
FF	10	10.	4.2	6.7	10	7	4	4	55.9
GG	10	10.	5.	10.	10	10	8	10	73.0
HH	10	10.	7.5	10.	10	10	6	10	73.5
II	10	10.	5.8	10.	10	10	6	4	65.8
JJ	10	10.	7.5	10.	10	7	6	4	64.5
KK	10	10.	5.8	10.	10	10	2	2	59.8
LL	10	10.	3.3	10.	10	10	6	10	69.3
MM	10	10.	6.6	10.	10	10	6	4	66.6
NN	10	10.	6.6	10.	6	7	6	4	59.6
OO	10	10.	5.8	10.	10	7	6	4	62.8
PP	9	7.5	4.2	6.7	10	7	4	4	52.4
QQ	9	7.5	3.3	10.	10	7	6	4	56.8
RR	9	7.5	3.3	10.	10	7	8	4	58.8
SS	9	7.5	5.	8.3	10	7	7	4	57.8
TT	9	7.5	4.2	10.	10	10	2	2	54.7
UU	10	10.	4.2	10.	10	10	4	4	62.2
VV	10	10.	5.	10.	10	7	2	2	56.0
WW	8	7.5	3.3	6.7	10	7	4	4	50.5
XX	8	7.5	5.8	10.	10	10	6	10	67.3
YY	8	7.5	5.8	10.	10	10	6	10	67.3
ZZ	8	7.5	5.8	10.	6	7	6	10	60.3
AAA	8	7.5	4.2	10.	6	7	4	4	50.7

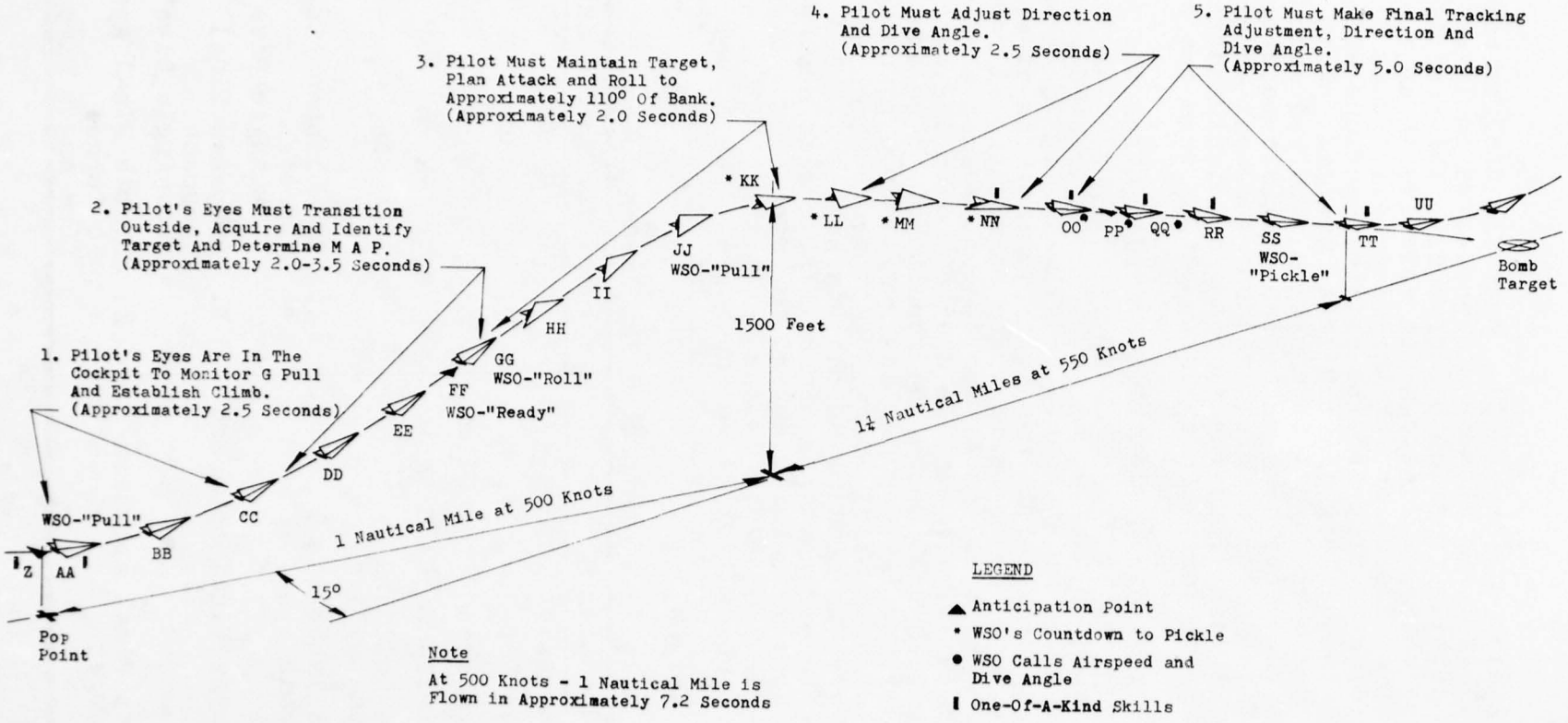


Figure 3. Pop-Up analysis diagram.

Weapons System Officer (WSO). Once the diagram was complete, each skill (C-Me-Mo element sequence) was analyzed for specific details of pilot performance. The positioning of element sequences was determined relative to an approximate elapsed time allocation for the maneuver. Items 1 through 5 on the diagram describe the critical actions which must be performed if the task mission is to succeed. This analysis revealed where the unattached skills occurred during this task portion. Four very significant skills occurred at the outset of the portion (Z and AA) and the most crucial skills (DD and EE) identified the target and determined the Minimum Approach Parameters (MAP). These skills were one of a kind.

6. Analysis of Unattached Skills (from the pop point to ordnance delivery, Z through UU) - This analysis approached the unrelated or unattached skill from the standpoint of determining the relationship and similarity to other skills in the data base. This was done by examining other skill cards within a sorting slot where an unattached Pop-Up skill occurred. The skill cards for the unattached skills were also correlated with surface analysis data for more complete analysis. Table 13 shows the results of these comparisons. As can be seen, initial skills from the pop point do not have any kindred skill among the other representative tasks. The delivery was similar to the Low Angle Dive Bomb skills; however, the aircraft was a more stable platform during the Low Dive Bomb - thus accounting for many of the differences in skill requirements. It was determined that in spite of this, the two delivery sequences were close enough to make the Low Angle Dive Bomb a good learning sequence for the Pop-Up delivery.

Table 13. Unattached Skills Comparison

Pop-Up Skill		Possible Kindred Skill
Z.	Prepares for Pop-Up	None
AA.	Starts Pop-Up	None
DD.	Establishes Level Climb	None
EE.	Continues Level Climb	None
NN.	Stops Roll and Maintains Dive	None
OO.	Establishes Final Approach	X. Establishes Final Approach (Low Angle Dive Bomb)
PP.	Prepares Final Approach	Y. Prepares Final Approach (Low Angle Dive Bomb)
QQ.	Starts Final Approach To Target	Z. Starts Final Approach To Target (Low Angle Dive Bomb)

7. Training Task/Skill Analysis - The purpose of this analysis was to determine which skills from other representative flying tasks would have rehearsal value in training for the Pop-Up task from the pop point through ordnance delivery. It has already been shown in the analysis of unattached skills that the Low Angle Dive Bomb task delivery contained kindred skills to the Pop-Up delivery.

Further, by reviewing the skill distribution information contained in Table 8 the grouping of skills from other tasks could be studied and tallied. It was found that skills: BB, CC, FF, GG, HH, II, JJ, KK, LL, and MM were also found in the Reversal, Low Yo-Yo, Dive Toss, Nuclear LADD and Low Dive Bomb. The highest concentration of skills laid in the Reversal and Low Angle Dive Bomb. The proficiency of the Reversal and Low Angle Dive Bomb tasks would constitute rehearsal of 11 of the 22 skills, or 50 percent. There were five of the 22 skills, or 23 percent, which had no direct relationship to any other skills in the data base and 27 percent of the skills could be rehearsed by training in the Low Yo-Yo, Dive Toss, and Nuclear LADD. Although this analysis undertook to examine only a small portion of a task, it is possible to do a training analysis of an entire task or determine the task/skill relationships between a group of tasks.

8. Information Analysis Summary - Seven analysis techniques have been used to gain insight into the problems of the Low Angle Pop-Up task. The taxonomy was essentially an objective tool; however, care must be taken not to read too much into a specific data area since not all areas of investigation were as fruitful as others.

The analysis investigation showed that the Pop-Up task was a unique task even on a controlled range. It has been shown that 43 percent of all the skills in the task were not directly related to other skills in the data base. The analysis of unattached skills has indicated that there are similar or kindred skills associated with some of these unattached skills.

A generalization of the task showed that it contained both air-to-air and air-to-ground characteristics. This was also true for the specific area from the pop point through the ordnance delivery. The task difficulty analysis showed that the actual skills involved in the Pop-Up were not in themselves as difficult as the skills of some other tasks. In looking at the task diagram, however, it can be seen that the short time frame in which these skills needed to be successfully completed added a significant or criticality factor not found in any other task. This fact,

coupled with the one-of-a-kind status of four of the first six skills starting at the pop point, helped to delineate the potential problem area. It should be pointed out that, perhaps, the most crucial skills of the Pop-Up occur at DD and EE of the task shown in Figure 3, and neither of these skills may be rehearsed in any of the other representative tasks. Two tasks in which a pilot should be completely proficient, specifically pointed out by the taxonomy, are the Reversal and the Low Dive Bomb, one an air-to-air task and the other an air-to-ground task. An area which was not specifically analyzed was Command Pilot (CP)/WSO communication. The analysis diagram showed the communication points and what was said. When the diagram was reviewed with the surface task analysis, it could be noted that much of the WSO communication occurred in highly loaded cueing situations. The input index was the highest of any representative flying task. Some of the cueing information could also be in conflict with what the pilot sees, or perhaps does not see. For instance, the pilot must go from eyes-inside to eyes-outside the cockpit, scan an area, detect the target and determine his MAP in skills DD and EE. If the pilot has not sorted out all these requirements by the "ready roll" command, but commits as commanded, the subsequent flying skills, though only relatively difficult, could prove highly disorienting.

The taxonomy also showed a needed proficiency in a number of air-to-air tasks such as the Reversal. The emphasis on air-to-air skills in the Pop-Up has indicated that a pilot who is to engage in this task should be current and highly qualified in air-to-air maneuvers. It is not within the scope of this research to draw specific conclusions; however, taxonomic data showed the Low Angle Pop-Up to be highly unique with very broad skill requirements, many of which need to be performed with near zero tolerance.

AIR-TO-AIR AND AIR-TO-GROUND TASK SEQUENCING METHODOLOGY

A general analysis of air-to-air and air-to-ground skill is contained in Appendix A of this volume. The procedures from this analysis became the basis from which the task sequencing methodology described within this section of Volume III was derived. This general or broad scope analysis provided insight into the behavioral characteristics of the representative tactical air-to-air and air-to-ground skill requirements. It did not, however, provide a tangible starting point from which to sequence the representative tactical tasks and skills for the most effective training of novice pilots. It was determined, therefore, that additional data would be needed. These data should come from the training experience of the student pilot. For this reason, a group of advanced Undergraduate Pilot Training (UPT) tasks and skills were analyzed. The basic work for this analysis had already been completed by Meyer, et al., in Volume III of a Behavioral taxonomy of undergraduate pilot training tasks and skills. Table 14 shows the seven representative UPT tasks chosen for inclusion in the data base.

Table 14. Representative UPT Flying Tasks

Task Number	Task Name
Ct-1	Loop
Ct-2	Barrel Roll
Ct-3	Aileron Roll
Ct-4	Cloverleaf
Ct-5	Cuban-8
Ct-6	Immelmann Turn
Ct-7	Vertical Recovery

It should be noted that all of the tasks are aerobatic in nature. These were chosen because they have some resemblance to the air-to-air work of tactical flying. The choice was also considered reasonable since air-to-air tasks also contain a rather high frequency of air-to-ground skills as shown in the general analysis contained in Appendix A. The skills from these UPT tasks were classified and added to the taxonomy of tactical flying skills. The UPT Task and Skill Distribution Data can be found in Appendix F. (Note that all kindred skills are shown with an asterisk.)

Basic UPT/Tactical Flying Data Comparison - A total of 103 UPT skills were isolated by the taxonomy and these skills were classified into 34 sorting slots of the taxonomic matrix system. The following is an overview of the UPT/ Tactical Flying Data.

1. UPT and tactical skills were found to be compatible within the same taxonomy.

2. Forty-four of the 103 UPT skills had either identical or kindred behavioral characteristics to the representative tactical skills while 59 skills had no direct relationship.

3. Of the seven UPT tasks, the Barrel Roll, Cuban-8, and Immelmann Turn were found to contain the most identical or kindred skills with the representative tactical skills.

4. Sixty-five of the 284 air-to-ground skills were identical or kindred to the UPT skills.

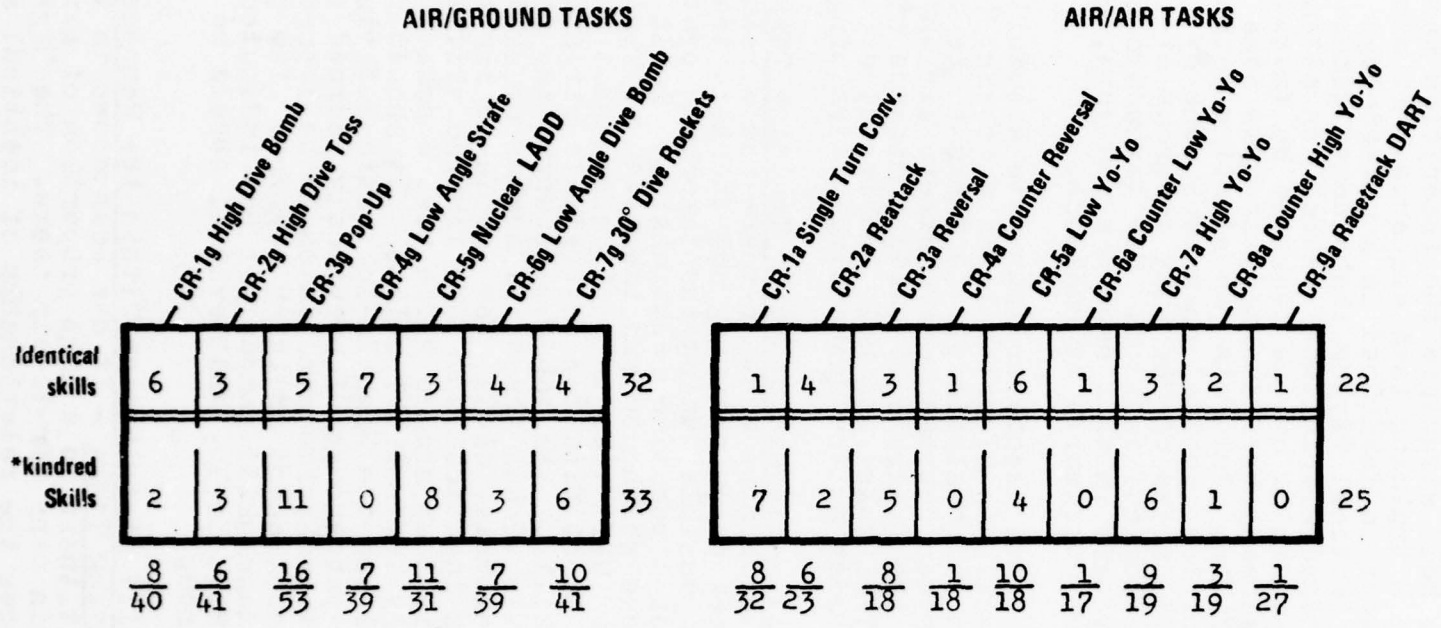
5. Forty-seven of the 191 air-to-air skills were identical or kindred to the UPT skills.

Tables 15 and 16 give a complete breakdown of the above information.

Table 15. UPT Tasks Having Skills Identical and Kindred to Air-to-Air and Air-to-Ground Tasks

	Loop	Barrel Roll	Aileron Roll	Clover leaf	Cuban - 8	Immelmann	Vertical Recovery	
Identical skills	3	11	0	3	8	7	5	37
*kindred Skills	2	0	0	2	2	0	1	7
Totals	5	11	0	5	10	7	6	

Table 16. Air-to-Air and Air-to-Ground Tasks
Having Skills Identical and Kindred to UPT Skills



Total Identical & Kindred Skills- 65
Total Air/Ground Skills-284

Total Identical & Kindred Skills- 47
Total Air/Air Skills-191

The data presented in Tables 15 and 16 were found to contain information which would assist in formulating a rationale to help structure the priorities needed for establishing a training task sequence. It should be understood that what is described is a methodology for sequencing a series of tactical flying tasks based generally on the skills contained within those tasks. An attempt was made to relate the skills of the tasks to be taught with those which have already been learned, in this case the representative UPT skills. This was the starting point. The actual sequencing of the tactical tasks was done by relating dominant skill areas of one task or group of tasks with another in a logical fashion. The taxonomic system played an important part in this sequence analysis, and the steps are described as clearly as possible.

The analysis describes four data acquisition areas: (1) skill analysis of prior training tasks; (2) the skill distribution and analysis of the tasks to be taught, in this case the sixteen representative air-to-air and air-to-ground tasks; (3) the analysis of skill dominance within the representative tasks; and (4) the impact of the skill difficulty index on the sequencing of training tasks.

1. Skill Analysis of Prior Training Tasks - It was possible to determine whether there was a relationship of skills between prior training and the next training segment. It was also possible, using the taxonomic system, to quantify the extent of a positive relationship. Table 16 shows the tactical tasks which contain identical or kindred skills to the prior (UPT) training. It shows that this relationship can be identified for both air-to-air and air-to-ground tasks and skills. The table also shows the number of related skills versus the total number of skills for each task. For example, CR-5a, the Low Yo-Yo air-to-air task, contains six identical and four kindred skills for a total of ten of eighteen skills which have a positive relationship to previously learned UPT skills. It should be noted that the Reversal and the High Yo-Yo tactical flying tasks also have a high percentage of previously learned skills which make these tasks prime candidates to be learned first during the subsequent training segment. The prior training versus new task/skill comparison has indicated that the Low Yo-Yo, High Yo-Yo, and Reversal should be taught first as a task group.

2. Skill Distribution Within the Representative Tactical Flying Tasks - It has been shown in the previous section that there is a high proportion of air-to-ground skills within many air-to-air tasks. The High Yo-Yo in Table 17 shows the relationship of identical and kindred

Table 17. Task/Skill Distribution Within the High Yo-Yo

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
8a(B)*, 5a(A)	A-327	2g(O)*, 3g(N)*, 4g(C)*, 1g(P)*, 2g(C)*, 6g(C)*
	B-275	
7a(N)*, 9a(Y)*	C-280	
1a(U)	D-200	3g(T)*
7a(L)*, 2a(I), 2a(K)	E-279	5g(O), 7g(X), 7g(Y)
6a(O)*	F-256	6g(HH), 3g(VV)*, 7g(M)* 1g(M)*
4a(O)*, 5a(K)*, 5a(F), 9a(M)	G-337	4g(U), 3g(FF)*, 4g(II)* 1g(W)*, 3g(S)*
2a(U), 3a(I), 5a(C), 5a(G), 5a(L), 5a(N)	H-280	2g(S), 4g(R), 4g(V), 6g(Q), 6g(U)
7a(J)*, 1a(DD)*	I-277	
7a(I)*, 1a(DD)*	J-277	
5a(M)*, 9a(S), 9a(L)	K-276	3g(BB)*, 3g(KK)*, 5g(I)*, 4g(HH)*, 5g(I)*
7a(E)*, 2a(I)*, 2a(K)*	L-279	1g(X)*, 7g(X)*, 7g(Y)*
5a(O), 6a(N), 9a(AA)	M-280	3g(HH), 5g(CC)
7a(C)*, 9a(Y)*, 5a(O)*, 6a(N)*, 7a(M)*, 9a(AA)*	N-280	3g(HH)*, 5g(CC)*
	O-17	2g(OO), 6g(MM), 1g(NN)*, 5g(F)*
	P-392	
5a(I)*, 1a(D), 3a(L), 3a(M)	Q-277	3g(MM)
	R-277	
	S-477	

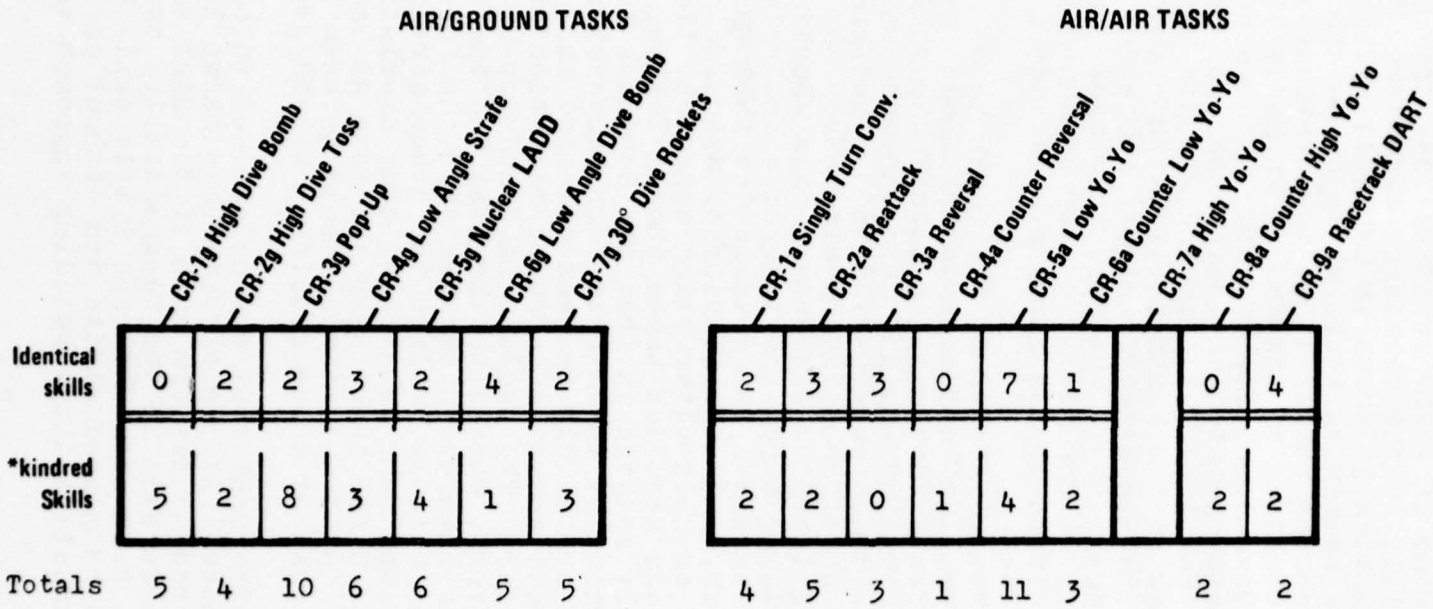
skills of this maneuver with the skills from other tactical flying tasks. It can be seen that each skill within this task is rich in air-to-ground flying skills. For this reason, it was deemed necessary to determine exactly how, and in what manner, these skills were represented in air-to-ground tasks.

A tabulation of related skills was made for each skill of the three candidate air-to-air tasks. This was done by tallying the identical or kindred skills listed in the right-hand and left-hand columns of the Task/Skill Distributions of the Low Yo-Yo, High Yo-Yo, and Reversal tasks. The results of this tabulation showed the precise relationship between the skills of these three air-to-air tasks and all the other skills contained across all tasks. This method of data analysis showed that the Reversal, and the High and Low Yo-Yo tasks were more strongly related to the Low Angle Strafe, Low Angle Dive Bomb, and Dive Toss air-to-ground maneuvers. Table 18 shows the results of this tabulation effort. A tabulation was then made of skills across tasks for each representative tactical flying maneuver to gain a similar insight into how the skills of one task are related to the skills and behavioral characteristics of another task. This tabulated information can be found in Appendix D. Analysis of this type thus far accounted for the sequencing of these three air-to-air and three air-to-ground tasks.

3. The Analysis of Skill Dominance and Continuation of Task Sequencing - It can be seen that the taxonomic information has provided both insight and specific direction into the problem of task sequencing. The analysis will not, however, provide data without the need for logical, or sometimes intuitive, judgments on the part of the training specialist. In this case, the next three tasks were selected as a logical outgrowth of previously selected tasks. These were the counter maneuvers to the Reversal, High Yo-Yo, and Low Yo-Yo. The tabulation of skills across tasks for these maneuvers, listed in Appendix D, showed that their skills were not found in any great concentration in other air-to-air or air-to-ground tasks. They are most important, however, and their sequencing in at this point would allow a student to reinforce prior learning on the High Yo-Yo for example, while another is introduced to the counter task by the instructor.

Sequencing thus far has included: (a) High Yo-Yo, (b) Low Yo-Yo, (c) Reversal, (d) Low Angle Strafe, (e) Low Angle Bomb, (f) Dive Toss, (g) Counter High Yo-Yo, (h) Counter Low Yo-Yo, and (i) Counter Reversal.

Table 18. Tasks Containing Skills
Identical and Kindred to the High Yo-Yo

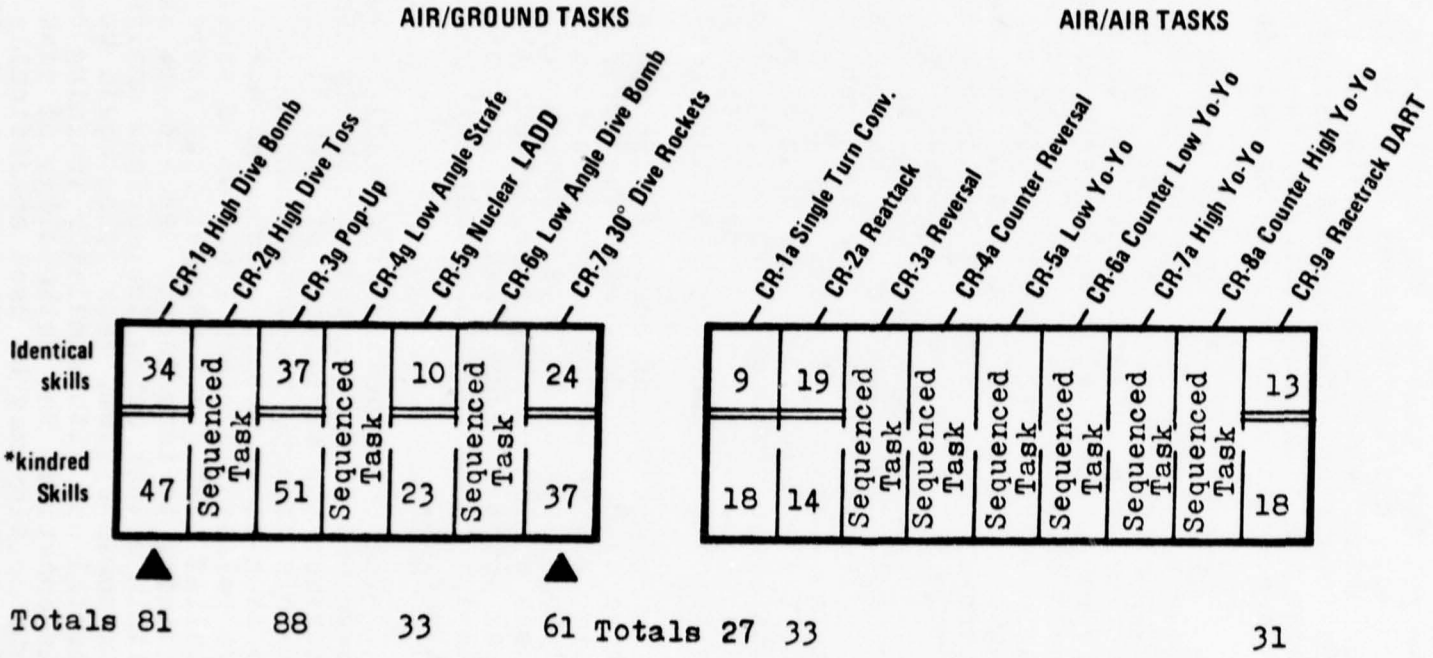


It was then necessary to evaluate the basic skills derived from the proficiency of the tasks listed above to determine if their rehearsal has provided an accumulation of skills in the remaining maneuvers. A tabulation of this information is shown in Table 19. This table shows skills in the remaining tasks which have been already introduced through the rehearsal of the previously sequenced maneuvers. The weighting of the tables in Table 19 indicates that the High Dive Bomb, Pop-Up, and 30° Dive Rockets would be the most appropriate candidate tasks for the next sequence, but only the High Dive Bomb and Rockets tasks were selected because of their similarity with previous weapons delivery patterns. A slightly higher number of skills are shown for the Pop-Up task; however, this task like the Nuclear LADD is done at low altitude over a range area which differs from air-to-ground maneuvers already accomplished.

The remainder of the tasks to be sequenced were, perhaps, less oriented to taxonomic rationale; however, the Task/Skill Accumulation Data Table still has value in terms of presenting insight into the sequencing problem. At this point it can be observed that a pattern has emerged which shows an alternating of air-to-air and air-to-ground tasks in the training sequence. This should not be considered surprising since the taxonomic analysis of the representative tactical tasks indicates that many air-to-air tasks contain, and thus reinforce, specific air-to-ground tasks. Based on this alternating approach, the Single Turn Conversion and Reattack tasks should follow. These two tasks are closely related in that the Reattack is essentially an extension of the Single Turn Conversion. Likewise, both tasks are highly systems oriented and also require the greatest amount of crew coordination of any tasks sequenced thus far. The Nuclear LADD and Pop-Up, both low level maneuvers, should be the last two tasks sequenced by group. It has been shown earlier that the Pop-Up task was rather unique because, unlike the other air-to-ground tasks, it contained many behavioral characteristics of an air-to-air task. Since both tasks are done at low altitude, a comfort level for low altitude should be established prior to the rehearsal of these remaining air-to-ground tasks.

The DART task was determined to be the last in the sequence. It has already been shown that the skills required to perform much of the DART task are not found anywhere else in the representative tasks. It has, therefore, been shown to have little skill building value and could be placed at the end without compromising the accumulative skill building approach to task sequencing.

Table 19. Task/Skill Accumulation Data



4. Skill Difficulty and Task Sequencing - A skill difficulty value and corresponding task difficulty index could also be used to assist in the sequencing of flying tasks. Table 20 shows the general grouping of tasks in column A as described thus far in this section. No emphasis has yet been made to the final order within each group. The task difficulty index found in Appendix E was used to further establish a priority of the tasks within each air-to-air or air-to-ground grouping. Column B in Table 20 shows the final sequencing of tasks within each group and thus completes the sequencing methodology.

Conclusion - The proper sequencing of tasks within a training context is important so that there can be a rational progression of events and situations to be learned. It is also considered important that total training rationale be defensible, both in terms of philosophy and task positioning within a specified training schedule. The basic learning philosophy in this section has been one of logical skill building so that the tasks, which have been learned, have a direct relationship to the tasks that remain to be learned. It should be pointed out that this section presents a methodology for accomplishing this concept. The examples used have necessarily been confined to selected UPT tasks and representative tactical flying tasks. Because of this, the data base was somewhat limited. The tasks which form this data base, however, are real and constitute a reasonable sampling of maneuvers. The data, thus, have a real-world orientation which should give the sequencing methodology a similar real-world flavor.

In an applied context, the sequencing of the representative tasks would require further considerations. For example, the use of a complete data base of UPT and tactical flying tasks would impact the suggested sequence. Other tasks would probably come between them which would make the task groups larger. Availability of equipment would, perhaps, also require sequencing trade-offs in an applied situation.

The introduction of a viable air-to-air and/or air-to-ground simulator would probably change the sequence and increase the efficiency of a skill oriented training program. In this regard, the understanding of how skills are related to each other within a task and how skills and skill groups are related to other tasks would provide the training specialist with great insight into where and how much simulation training to introduce. Since basic skills can now be plotted within a task using the surface analysis and the rest of the taxonomic system, weak areas could be determined and accurately "beefed up" with simulator training before the student entered the cockpit. The methodology of task sequencing presented in this section may be used specifically to develop a more efficient and integrated training syllabus structure.

Table 20. Final Flying Task Sequence

Column A		Column B	
Preliminary Grouping		Final Sequential Grouping	Difficulty Index
1	Low Yo-Yo	a. Reversal	64.0
	High Yo-Yo	b. High Yo-Yo	64.3
	Reversal	c. Low Yo-Yo	66.0
2	Low Angle Strafe	a. Low Angle Strafe	59.8
	Low Angle Dive Bomb	b. High Dive Toss	61.1
	High Dive Toss	c. Low Angle Dive Bomb	61.1
3	Counter Low Yo-Yo	a. Counter High Yo-Yo	61.0
	Counter High Yo-Yo	b. Counter Reversal	61.5
	Counter Reversal	c. Counter Low Yo-Yo	62.0
4	High Dive Bomb	a. 30° Rockets	59.7
	30° Dive Rockets	b. High Dive Bomb	60.0
5	Single Turn Conversion	a. Single Turn Conversion	56.9
	Reattack	b. Reattack	66.8
6	Nuclear LADD	a. Nuclear LADD	56.4
	Pop-Up	b. Pop-Up	58.9
7	Racetrack Dart	a. Racetrack Dart	65.6

METHODOLOGY TO DETERMINE SIMULATOR CAPABILITY REQUIREMENTS

The potential of simulation as a training medium has long been recognized. The growth of digital computer technology and electronic display capability has progressed to the point that the industry can now provide almost any simulator capability the military services can define. The airlines now use simulators as the keystone of their aircrew training program. Airline and Federal Aviation Administration (FAA) confidence in and reliance on simulation have grown to the point that they have systematically substituted simulator hours for flying hours for initial aircrew checkout of an aircraft and the transition from one aircraft to another. Simulator checkrides have replaced flying checkrides for certain requirements. The net result has been better trained crews, lower flying costs, better utilization of aircraft, and a phenomenal safety record.

It can be argued that the aircrew training requirements for tactical military aircrews are different and more complex than the relatively benign takeoff, navigation, and landing scenarios required in airline-type flying; thus, the two activities are not comparable. This type of reasoning has evaded the real problems: the development of comprehensive plans to investigate training requirements, the translation of these into simulator capability requirements, and finally, the performance of necessary trade-offs to arrive at a simulator specification.

If a simulator is to be an effective training device, its definition and capability must be based on specific user requirements regardless of whether the simulator is to be a part of an initial aircrew tactical training course or used solely as a supplement to an aggressive flying training program at the tactical squadron level. This taxonomy and its data base identified and classified the skills needed for tactical mission performance and, thus, provided an excellent starting point from which to begin a definition of simulator capability requirements.

The successful approach taken by the airlines has been that of re-creating the total flying environment as completely as possible. The training situation thus created emulates the real world. The surface task analysis of the taxonomy has provided a data base for identification of the tactical aircrew task requirements and cueing environment necessary to emulate real-world tactical flying missions. A trial methodology was devised which utilized the taxonomic system data to establish a framework to determine tactical simulation

requirements. This methodology involved determination of the actual cue requirements for a given task and identification of the simulation requirements necessary to provide these cues. Specifically, the procedure involved four steps:

1. Determine specific flying task or tasks to be trained.
2. Perform a surface analysis for each of these tasks.
3. Compile a list of all cues identified in the surface task analyses.
4. Delineate simulator requirements from a cues list.

For purposes of exercising this trial methodology, a sample flying task was selected from the list of sixteen representative tasks which had already been analyzed for taxonomic classification. The task chosen was the air-to-air intercept, Single Turn Conversion. This choice was arbitrary. Step 3 was to compile a complete list of cues for the Single Turn Conversion as identified in the analysis. Table 21 shows these cues identified by category. With the cues sufficiently identified, it was then possible to begin the delineation of the actual simulator requirements.

Table 21. Cue Requirements for Air-to-Air Intercept/Single Turn Conversion

Visual	Aural	Control	Motion
Horizon	Aircraft Sound	Stick	Positive/ Negative G
Flight Instruments	Communication with WSO	Microphone (Mic.) Button	Longitudinal Acceleration
Radar Scope		Throttle	Pitch
Armament Status Panel		Rudder	Roll
		Master Arm Switch	

The conversion of certain cues, such as aircraft sound and most control inputs, to corresponding simulator requirements was readily apparent. Visual cues defining the horizon, communication with the WSO, and motion information, however, were not as readily translated into simulator terms. At this point, it was determined that a cues/simulator subsystem comparison could be established which would equate those less obvious cue requirements into meaningful simulator descriptions. The following simulator subsystem categories were established:

1. Crew station system
2. Visual display system
3. Aural cues system
4. Motion cues system

The cues from Table 21 were then redefined in terms of simulator subsystems, components, or capabilities necessary to provide the respective cue. The following list shows the relationship between the real-world cues and the required simulator equivalent.

Visual

Horizon	Visual Display - Out of cockpit visual horizon with pitch, roll, and yaw freedom
Flight Instruments	Crew Station - Representative functional instruments including: Attitude Director Indicator, Mach/Airspeed Indicator, Altimeter, Vertical Velocity Indicator, and Horizontal Situation Indicator
Radar Scope	Crew Station - Radar Scope with representative dynamic display
Armament Status Panel	Crew Station - Representative functional armament status panel

Aural

Aircraft Sound	Aural Cue - Dynamic engine, wind over canopy and missile fire sounds
Communication with WSO	Crew Station - Aft crew station with suitable WSO displays or WSO function provided from outside of simulator crew station area

Control

Stick	Crew Station - Flight control stick with appropriate grip functions
Mic. Button	Crew Station - Throttles with mic. button
Throttle	Crew Station - Throttles
Rudder	Crew Station - Rudders
Master Arm Switch	Crew Station - Master arm switch

Motion

Positive/ Negative G	Motion System - Capability to raise/lower simulator
Longitudinal Acceleration	Motion System - Capability to move longitudinally
Pitch	Motion System - Capability to pitch simulator
Roll	Motion System - Capability to roll simulator

A description of corresponding simulator component/capability has now been developed which when properly effected and driven with suitable programs will provide the cueing environment for the pilot to perform the task of the air-to-air intercept, Single Turn Conversion.

The simulator thus described is of course incomplete, since the methodology does not address any requirements for implementation of instructional features such as instructor monitor displays or instructor controls. It also does not have within its framework the capability to determine fidelity requirements (including the question of motion). The net result of the methodology to this point has been to describe the basic aircrew environment which should be created for the emulation of the real-world task.

Instructional Requirements - To attempt identification of instructional feature requirements, the original methodology must be expanded. After some consideration it was decided to review the task analyses again to determine what simulator capabilities would be required for most effective instruction and what information an instructor pilot would require to properly evaluate the student's performance on the individual task. The determination of the specific information/simulation capabilities required by an instructor would be subjective opinions which would vary depending on the background of the individual. It was, therefore, desirable that several instructors should participate in this assignment and form a collective list of information/capabilities required. This list should be prepared with consideration of known simulator capabilities but without regard for known or suspected simulator limitations since simulator technology is expanding at a rapid rate.

This additional area of the trial methodology was then exercised. An experienced tactical instructor pilot analyzed the task data to determine information and simulator capability required to effectively teach the task of air-to-air intercept/Single Turn Conversion. Two lists were prepared: one identifying the requirements for teaching each skill involved in the task individually (shown in Appendix H) and a second list which included these capabilities needed for implementing overall instructional strategies and techniques (shown in Appendix C).

Composite Simulator Capability - These lists were then integrated with the requirements for the task cueing developed earlier. The composite simulator capability requirements description, identified in Table 22, contains information on the total cueing environment necessary for the crewmember trainee and those informational displays and capabilities needed by an instructor to create a learning environment for the teaching of the Single Turn Conversion. These requirements generated by the methodology stated above using the taxonomic system as a data base are, in effect, the functional requirements for a simulator to train this specific task.

This same methodology can be applied to any task or group of tasks to determine the specific simulator requirements. It is logical to assume that related mission tasks may well require similar simulator capabilities; thus, a simulator designed to train one task may be capable of training a large percentage of the skills required for another task. The methodology would also identify the additional capability required to train both tasks. Following this logic, this procedure could be extended to all tasks required of a particular aircraft and so generate functional requirements for a full mission simulator.

Conclusion - The methodology described will identify the functional requirements for a simulator which would be the military equivalent of the airlines' approach to training - the simulation of the total environment and implementation of instructional techniques. This methodology does not provide a complete formula for simulation requirements generation. The performance of a number of specified areas required substantial subjective judgments, an expertise as a tactical aircrew instructor, and familiarity with simulation systems.

It should also be recognized that the development of such simulators for the tactical mission of the Air Force may be beyond available technical or financial resources. While these limitations should not be considered during the requirements definition, they must be addressed during a simulator acquisition phase. Many such factors must be considered before a simulator design is finalized.

Table 22. Composite Simulator Requirements for Training Task, Air-to-Air/Single Turn Conversion

1. Crew Station System - All listed equipment is to be geometrically and functionally representative of the F-4E

1.1. Structure including shell, seats, consoles, and instrument panels

1.2 Functional front cockpit controls and displays

1.2.1 Instruments: Attitude director indicator, mach/airspeed indicator, altimeter, vertical velocity indicator, and horizontal situation indicator

1.2.2 Radar scope with dynamic displays

1.2.3 Armament status panel

1.2.4 Flight control stick and grip

1.2.5 Throttles with mic. button

1.2.6 Rudders

1.2.7 Master arm switch

1.3 Functional aft cockpit controls and displays

1.3.1 Radar scope

2. Visual Display System

2.1 Out-of-cockpit visual horizon with active pitch, roll, and yaw freedoms

3. Aural Cues System

3.1 Dynamic engine sounds

3.2 Wind over canopy sound

3.3 Missile firing sound

4. Motion Cues System

4.1 Four degrees of freedom motion system (pitch and roll angle, vertical and lateral translation)

Table 22. Composite Simulator Requirements For Training Task, Air-to-Air/Single Turn Conversion (concluded)

5. Instructors Station

5.1 Displays

5.1.1 All aircraft relative geometry display in three-dimensional format, aspect rotatable

5.1.2 WSO scope display

5.1.3 Fighter heading for optimum intercept

5.1.4 Fighter attitude and heading

5.1.5 Fighter flight parameters (mach, airspeed, altitude, vertical velocity, G-force, angle of attack)

5.1.6 Target flight parameters (attitude, heading, mach, airspeed, altitude, vertical velocity, G-force, angle of attack)

5.1.7 Pilots radar scope

5.1.8 Fighters RPM

5.1.9 Fighters armament status

5.1.10 Missile performance (scoring)

6. Capabilities

6.1 Set up desired initial conditions (position and flight parameters of fighter and target)

6.2 Communicate with/monitor aircrew conversation

6.3 Command radar lock-on (if WSO position not filled)

6.4 Controls to "fly" target

6.5 Freeze simulation function

6.6 Instant Replay function

6.7 Replay of previously recorded runs function

6.8 Storage of numerous initial conditions

6.9 Hard copy printout of display information

7. Debrief Station

7.1 Replay trainees runs

7.2 All instructor displays available

7.3 Freeze replay mode

7.4 Hard copy from all displays

METHODOLOGY TO DETERMINE SIMULATOR TASK/SKILL TRAINING CAPABILITY

The purpose of this investigative effort was to develop and exercise a methodology that would identify which basic skills of a tactical flying task could be taught in a simulator of a specified capability. The approach in this investigation centered around the identification of cueing requirements based on the skills contained in the taxonomic system. These cueing requirements were then compared to the capabilities of the specified simulation device. Specifically, the methodology contained the following five-step procedure:

1. Identify and analyze tasks to be trained.
2. Describe the specification of a simulator so that a comparison of task/skill training requirements to simulator capability could be made.
3. Establish a cue weighting system which would reflect its training value and importance.
4. Compare each cueing requirement to the simulator capability.
5. Determine a percentage value which would evaluate the simulator training capability for each basic skill within a task.

Step 1. - The tasks chosen for use were the Low Yo-Yo (CR-5a) and the Counter Low Yo-Yo (CR-6a). The Low Yo-Yo was chosen because it was found to contain the highest number of skills which were identical or kindred to the skills within the other eight representative air-to-air tasks. The Counter Low Yo-Yo task was included as a natural complement since the defensive tactics to a maneuver should not be ignored in determining the training ability of a simulator device.

Step 2. - This step required that a simulator be defined and its capabilities described in such a way as to be comparable with the cue requirements derived from the surface task analysis data. While any simulator, real or imaginary, could be used for this analysis, it was determined to be meaningful to define a simulator with capabilities which could be used at the tactical squadron level. Thus, the device selected as the comparison training device is similar to the A/F -37U-T9 simulator. This comparison simulator is defined as having a single place representative cockpit,

being driven by a digital computer, and having a G-suit, a G-seat, and a computer-generated image three-window visual display system. Table 23 identifies the specific details of this device.

Table 23. Simulator Description

Cockpit

One-man crew station representative of forward cockpit of F-4E

Active Flight Instruments

Active Engine Instruments

Radar Scope

Active G-suit hook-up

G-seat

Visual Displays

Typical three-window computer generated image system which provides an air-to-air target, sky/earth horizon, patterned terrain, and ground target images. It also provides image fading for grayout and blackout. The forward field-of-view is 100° horizontally (± 50°) and 40° vertically (+25° and -15°).

Audio System

Engine and Afterburner Sounds

Armament Discharge

Angle of Attack Tone

Missile Seeker Tone

Computer System

Aircraft Dynamics

Simulated Weapon System

Weapon Trajectory Models

Air-to-Air Geometry Routines

Interface to Computer-Generated Image (CGI) System

Instructor/Computer Controllable Air-to-Air Target

Step 3. - This step was included because it was felt that all cues are not of equal value in the performance of skills and, thus, are not of equal importance in skill learning. The final weighting system used in this analysis is shown in Table 24.

Table 24. Cue Weighting System

Major Cues	Percent of Cue Importance
1. Visual Cues	75% of Total Cues Contribution
2. Aural Cues	10% of Total Cues Contribution
3. Control Cues	10% of Total Cues Contribution
4. Motion Cues	5% of Total Cues Contribution

This weighting system was devised intuitively by project researchers who were not only experienced pilots but also had considerable knowledge of simulation devices. The weighting, although determined to be reasonable, could be modified without affecting the methodology presented in this portion of the procedure.

The following is the rationale for the weighting figures shown in Table 24. Each basic skill within the taxonomy contains four major cue categories: Visual, Aural, Control, and Motion. In Table 24 each of these categories has been percentage-ranked in order of importance for the completion of all skills. It can be seen that visual cues have been considered of prime importance. The surface analysis shows that each of these major cue categories is made up of individual cues. In this methodology, each individual cue is considered to contribute equally to its respective skill category. For example, the individual pitch, bank, and target cues under the visual category would be considered to contribute equally, or one-third for each cue, to the total visual category of 75 percent. Similarly, two aural cues would each contribute half of the 10 percent allocated to the aural cue category.

Further investigation showed that there was typically one primary individual cue for each skill. This primary cue triggered the mental action which determined the motor action. This primary cue was usually visual and associated with the overall task goal or the goal of the task segment. If this cue was not available, the skill could not be satisfactorily performed. Therefore, it was determined that a primary cue for each skill must be available for learning to occur. If this individual cue was not available, the contribution of that cue category was concluded to be 0, regardless of the availability of other cues in that category.

Step 4. - In this step each cue requirement was compared to the simulator capability to determine its availability. It was found that these cue data as listed in the task analysis did not always contain sufficient information to compare directly to the simulator capability definition. For example, the task data did not define the specific pitch attitude of the aircraft when describing the visual cue as "pitch increasing." Since the simulator visual display system was described as having specific field-of-view limits, a method of amplifying the visual cue information was necessary. The sequential task diagram shown in Figure 4 illustrates the relative position of the Attacker and Target at each skill. This diagram information was used as an aid to establish aircraft pitch and bank attitudes and the line of sight to the target.

Aircraft attitude had to be defined for each skill to determine if the horizon was within the visual display field-of-view of the simulator. For each skill that contained the target aircraft as a visual cue, the line of sight to the target needed to be established to see if the target would be visible within the field-of-view available in the simulator. Results of this skill by skill comparison of cue requirements to simulator capabilities may be found in Appendix J.

The aural and control cues as listed in the task analysis were readily comparable to the simulator capabilities. In all cases, all cues were provided by the simulator and can be seen in Appendix J.

The motion cues for these tasks were addressed by concluding that the G-suit and G-seat were adequate devices to provide for all motion cueing for these tasks. These devices can provide both onset and sustained cues.

Step 5. - With the cue requirements versus simulator availability data complete, a percentage value could be given to the training capability of the comparison simulator on a skill for skill basis. This was done by applying a simple tally method to the data found in Appendix J to determine which skills could be trained at the 100 percent level and which would be less completely trained. The results of this tally are as follows: the comparative simulator used in this methodology could train 11 of the 18 skills of the Low Yo-Yo at the 100 percent level and the remaining 7 skills of this task at the 25 percent level. For the Counter Low Yo-Yo task, however, only 4 of the 17 skills could be trained at the 100 percent level and the remaining 13 skills would receive training at the 25 percent level.

One v One LOW YO-YO AND COUNTER LOW YO-YO

(Like Aircraft, Missile Shot, Controlled Range)

SITUATION - Attacker in approximately 5:30 position, 12,000 feet out, co-airspeed and airspeed.

SITUATION - Defender in a turn at high cruise.

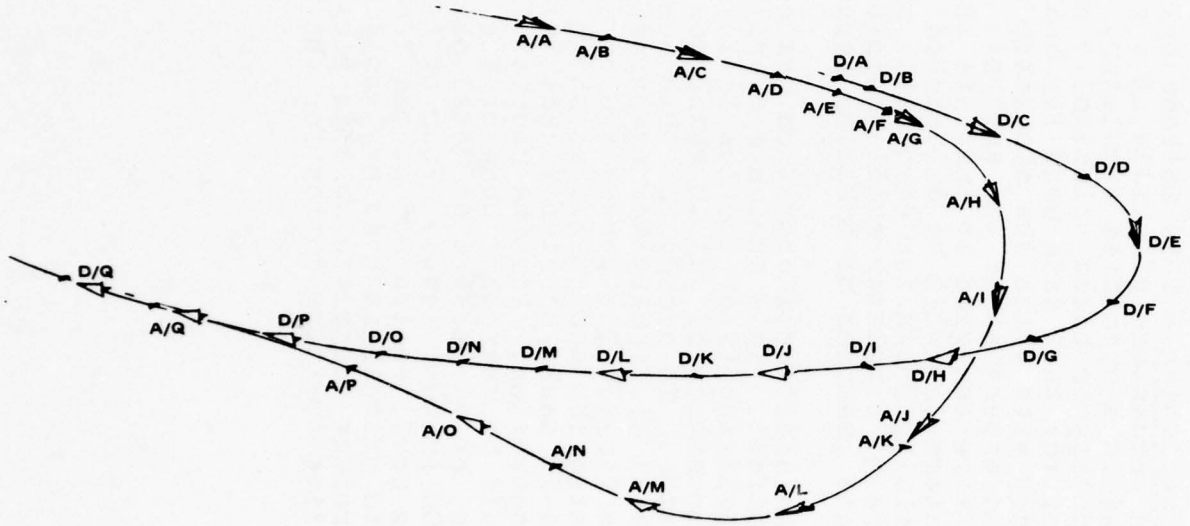


Figure 4. Task diagram of the Low Yo-Yo and Counter Low Yo-Yo.

This simulator, then, could completely train 61 percent of all the basic skills required for the Low Yo-Yo, but would fully train only 24 percent of the Counter Low Yo-Yo skills. The remaining skills of this defensive task would be only 25 percent trained, simply because the comparison simulator did not contain rearward visual capability.

Conclusion - This methodology can provide an indication of the percentage of skills of a given task that can be trained in a specified simulator. Effectiveness of this methodology is based principally on the accuracy and completeness of the task data used for analysis, the manner and accuracy with which the simulator capability is described, and the expertise of the analyst. The weighting factors which were assigned to indicate the relative importance of cue categories will be diminished if the final percentages of training shown for each skill are considered as a relative measure of simulator skill training ability rather than absolute measures of training capability.

An additional operation was conducted as a result of this effort. This analysis operation compared the basic skill difficulty of the Low Yo-Yo and Counter Low Yo-Yo to the percentage of skills which could be trained with the simulator. To accomplish this comparison, a rank order of the skill difficulty was prepared, listing the most difficult skills first. The percentage of skills trained was then indicated for each skill as shown in Appendix J. For the Low Yo-Yo task, no significant inference could be made for this operation. For the Counter Low Yo-Yo task, however, it could be seen that none of the eleven most difficult skills, or 65 percent of total skills, could be trained to the 100 percent level. Four of the six least difficult skills could be trained at the 100 percent level. The results of this methodology would certainly indicate that the trainer described in this section would not be an effective training device for the Counter Low Yo-Yo maneuver.

METHODOLOGY TO DETERMINE MOTION SIMULATION CONTRIBUTIONS AND LIMITATIONS IN TRAINERS

No motion simulation system can duplicate the motion cues perceived during actual flight. This is primarily due to the limited travel available in motion base systems. As a travel limit is approached, motion in that direction must be curtailed, and a deceleration and eventually stoppage of motion must occur. Since the aircraft may still be accelerating in the simulated situation, a false cue can be generated. Most motion simulation systems are programmed to return to neutral position, or the midpoint of allowable travel in each axis, after a movement. This deceleration and subsequent return to neutral is called "washout." Development of washout must consider vehicle attitude, rotational and translational accelerations, motion system limits and operational dynamics, and pilot perceptual thresholds of motion. The programming of motion systems is clearly more art than science at present.

A great many of the motion base systems in existence on training simulators are either not used, or "tuned" so that the actual movement of the simulator is very small or slow when compared to the design capabilities of the system.

It was thought that the taxonomic system could be used to investigate the subject of motion simulation. If the taxonomy could be exercised in such a way as to determine what the benefits or detriments of typical motion base systems were, this valuable information could be used for the development of new training systems.

The approach was to develop a methodology which would compare motion cueing required, as extracted from the task analysis, to motion cueing produced in a typical motion base system. The general procedure required the following steps:

1. Select an appropriate task for analysis.
2. Analyze that task to determine motion cue simulation requirements.
3. Identify a typical motion base simulator system for use in this comparison.
4. Identify the operating characteristics of this system in normal training operation.
5. Compare motion system requirements to capabilities available.

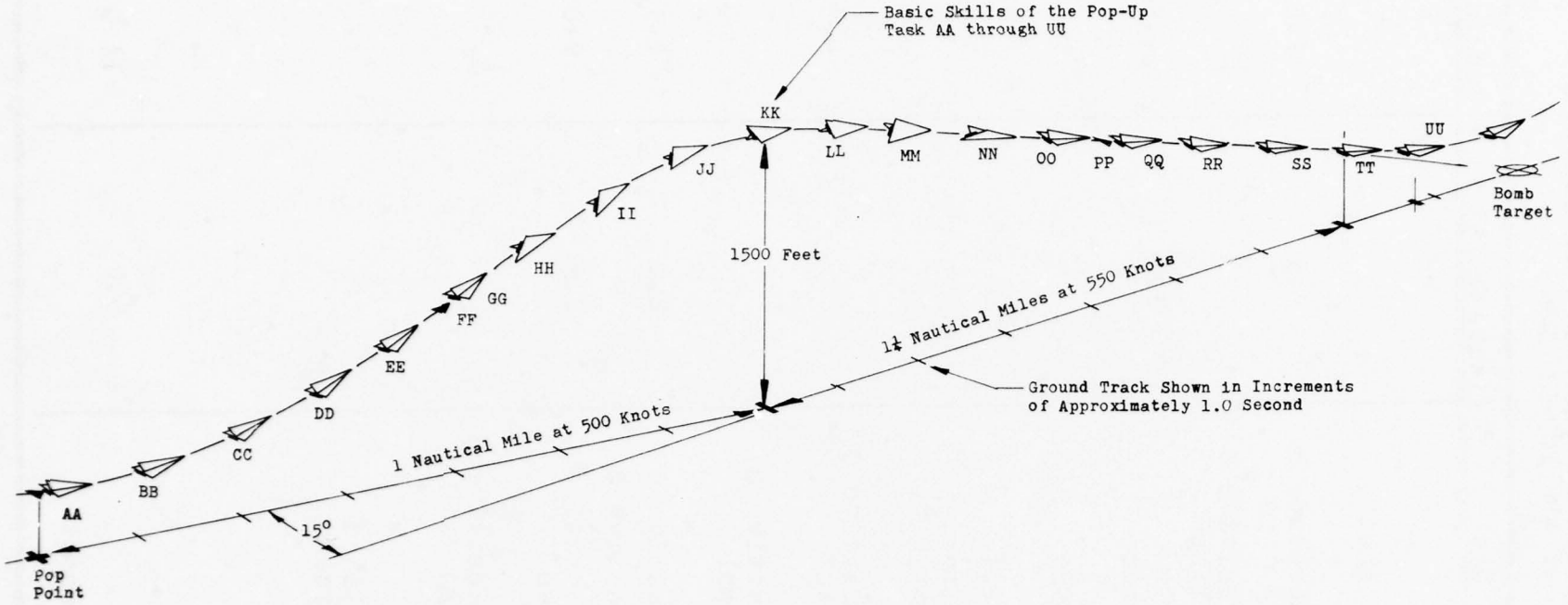
Step 1. - For this research, the selection of an appropriate task was largely determined by requirements identified to perform Step 2. That is to say, the determination of the motion cue simulation requirements necessitated that a time dimension be added to the task analysis data. This information was available only for a segment of Task CR-3g, the Pop-Up.

Step 2. - This task had been examined in detail earlier in this study and a time frame had already been established for the final attack segment of this task, skills Z through UU. Figure 5 shows this task segment. Table 25 was constructed from the motion cue data of the task analysis and the Pop-Up task segment analysis diagram. There were three motion cues identified: positive G, pitching, and rolling. For purposes of this investigation, buffeting motion cues were ignored. The Pop-Up task segment analysis provided incremental time between significant skills and total elapsed time, but it did not provide specific time durations for each of the motions identified. Table 26 was thus constructed to provide this information. Information about each of the three motion cues was plotted along a time axis. All information regarding motion start, change, or cessation was indicated with the respective skill. When points were required on the graph but no specific time frame was indicated from the segment diagram, a linear interpolation was made between known times. The information in Table 26 shows the duration of each of three motion cues required during this task segment. It should be noted that the magnitude of the cues is not identified by this analysis.

Step 3. - The procedure involved the identification of a typical motion base system for use in comparison. A device patterned after the Franklin Institute six-pole design was chosen. This configuration is the design basis for the newest USAF motion simulator for the F-15 aircraft.

Step 4. - This step identified the operating characteristics of such a system in its normal training operation. Single-axis positional limitations and peak velocities were obtained and are shown in Table 27.

The time that motion cues are available in each axis is determined by the magnitude of the commanded accelerations, the peak velocities, the excursion limits and the specific washout equations. The initial investigation into the development of washout equations indicated that this was an area of much subjective opinion. It seemed to be uniquely determined for each simulator and training situation and,



Note

At 500 Knots - 1 Nautical Mile is
Flown in Approximately 7.2 Seconds.

Figure 5. Task/skill segment of the Pop-Up diagram.

Table 25. Motion Cueing/Time Line Analysis of the Pop-Up Task

Skill	Motion Cue	Incremental Time	Running Time
AA	Normal G Buffeting	0	0
BB	Positive G Onset Pitching Up		
CC	Increased Positive G Pitching	2.5	2.5
DD	Decreased Positive G Pitch Stabilized		
EE	Normal G Pitch Constant	2.0	4.5
FF	Normal G Pitch Constant		
GG	Normal G Pitch Constant		
HH	Positive G Onset Pitch Constant Rolling		
II	Increased Positive G Pitching Down Rolling		
JJ	Constant Positive G Pitching Down Rolling		
KK	Constant Positive G	2.0	6.5
LL	Constant Positive G		
MM	Decreasing Positive G Pitching Down Rolling	2.5	9.0
NN	Decreasing Positive G Pitching Down Rolling		
OO	Normal G Pitch Stabilized Roll Stabilized		
PP	Normal G		
QQ	Normal G		
RR	Normal G		
SS	Normal G		
TT	Normal G	5.0	14.0
UU	Positive G Onset Pitching Up		

Table 26. Incremental Time Between Basic Skills and Total Elapsed Time for G, Pitch, and Roll

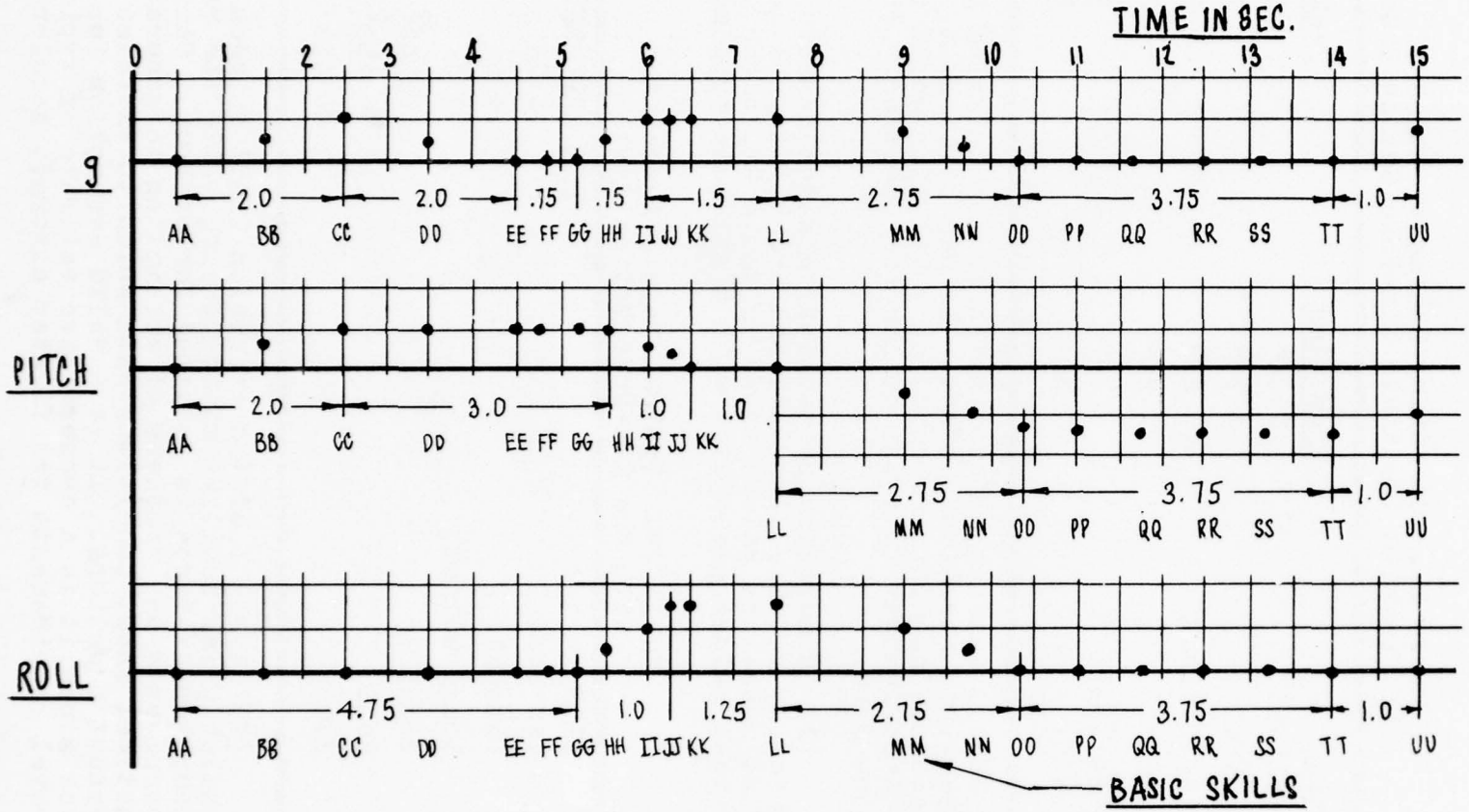


Table 27. Operating Characteristics of the Franklin Institute Six-Pole Motion Base

Axis	Excursion	Peak Velocity
Vertical	± 30"	24 ips
Lateral	± 30"	24 ips
Longitudinal	± 46"	24 ips
Pitch	± 20°	20 ips
Roll	± 20°	20 ips
Yaw	± 30°	20 ips

in short, was not a practical area for detailed investigation under this research project. It was still felt, however, that some assumptions could be made which would provide some limited insight into the motion cue question. These assumptions were:

(1) Simulation of tactical mission maneuvers will typically require translational and rotational accelerations of at least the values shown in Table 28, which are the typical values associated with a six-pole type motion system.

Table 28. Typical Values Associated with the Six-Pole Motion System

Axis	Peak Acceleration
Vertical	.4 G
Lateral	.4 G
Longitudinal	.4 G
Pitch	40 ips^2
Roll	40 ips^2
Yaw	40 ips

(2) One-half of the excursion limit in each axis is available for positive motion cueing while the remaining excursion distance is required for washout. This assumption circumvents the problems of attempting to generate hypothetical input conditions with which to exercise hypothetical washout equations. It is a valid assumption for this initial look since it is a conservative estimate of typical washout travel requirements for fighter aircraft accelerations.

Thus, if the comparison of Step 5 indicated that the provided motion cues were insufficient to meet requirements, the more stringent criteria of actual washout excursions would indicate that even less of the actual motion cue requirements would be met by motion base simulator systems.

To determine the amount of time the motion cues are available in this generalized motion base system, several equations needed to be solved. These calculations can be found in Appendix I. This appendix data shows that the generalized motion base system has a maximum .70 second available for positive cueing in vertical and lateral axes, and 1.04 seconds available in the longitudinal axis. Pitch and roll axes have .75 second for positive cueing.

Step 5. - This involved comparing the motion cueing requirements developed from analyzing the task data to those available in the motion producing device. From Table 26, it can be determined that increasing positive G is required for 2 seconds (AA to CC) and 2.25 seconds (GG to LL). Both of these time requirements exceed the positive cueing time of .70 second available. Pitching cues are required for 2 seconds (AA to CC), 1 second (HH to KK), and 2.75 seconds (LL to OO). These times also exceed the .75 second available. Rolling cues are required for 1 second (GG to JJ) and 2.75 seconds (LL to OO). Again, both cue requirements exceed cueing time available.

Conclusion - The five-step methodology for using the taxonomy has now been completed and indicated that the six-pole motion system will not provide the motion cues required to simulate those encountered in the final delivery segment of the Pop-Up task.

After this exercise was completed, it was considered appropriate to review the entire procedure and provide an evaluation of its worth concerning motion base simulators for training.

The fundamental conclusion serves to document what may well be a universal acknowledgment: that motion base simulators cannot duplicate real-world high G motion. The reason is that the physical travel restrictions provide absolute limits on the time that accelerations may be maintained. This is the main strength of the methodology rather than a weakness, as it puts into understandable perspective the pilots' comments that "it doesn't feel right," simply because it is not right.

There are two other limitations which also confine the effectiveness of this methodology: (1) the lack of a time line or acceleration magnitude information within the surface task analyses and (2) the oversimplification of the effects of washout considerations in the motion base systems. If it were desirable to pursue development of this methodology, these limitations could be overcome by collecting the appropriate amplifying data from sources available within the Air Force. For example, explicit timing and acceleration data could be obtained from the Air Combat Range (ACR) at Nellis AFB or from the Simulator for Air-to-Air Combat (SAAC) at Luke AFB. The equations for motion washout should also be obtainable from any training activity utilizing a motion base simulator. Meaningful interpretation of these data could then be provided in the acceleration regime as well as the time duration regime introduced in the current methodology.

CONCLUDING STATEMENT

Volumes I and II of this research have described how the analysis and taxonomic classification systems were derived. Both of these discussions followed procedures established in the Behavioral taxonomy of undergraduate pilot training tasks and skills, Meyer et al., as a departure point. Volume I dealt with the analysis of tactical flying tasks and showed that it was possible to describe these maneuvers in sufficient detail to be used in a taxonomic system. Sixteen tasks were chosen as being representative of nine air-to-air and seven air-to-ground Basic Fighter Maneuvers (BFM) which can be performed in the F-4E aircraft. Although the sixteen tasks represented about 50 percent of the BFM tasks, they are only a fraction of the total F-4 task list. A complete F-4 surface task analysis would require the addition of another 80 tasks to make up a complete data base. With such a data base, it is estimated that the taxonomy would extract approximately 4500 basic skills from the tasks. Volume II of this research provided a classification and taxonomic structure which, like the analysis in Volume I, was carefully expanded to include the behavioral complexities found in the BFM tasks, and it was determined to have sufficient depth to accommodate all tactical flying maneuvers.

All the reports of this research were directed to the user and specifically oriented to fighter pilots themselves. In this respect, Volume III concluded this research effort with specific training applications toward which the taxonomy could be directed. These applications or problem areas were suggested by members of the F-4 OS team at Luke AFB. This was done to determine if the taxonomy could be made to address real-world tactical flying training problems. At the time these problems were accepted by project researchers, no taxonomic methodology existed for their solution. These OS oriented problems showed both the strengths and weaknesses of the taxonomy.

Volume III described the application of seven problems. These were divided in two categories: those which are maneuver oriented, and those which are simulator oriented. The taxonomy and its specific components show better problem resolution capabilities in the maneuver oriented areas. This finding was not surprising since the taxonomy was designed to address such problems. The simulation application areas also show that taxonomic data can be very useful. However, additional data input, particularly in the surface task analysis, would be required for better problem resolution. The methodology as applied to all problem areas appears sound and demonstrated that the taxonomic approach could be utilized to aid in the solution of diverse training problems.

The data base of sixteen selected maneuvers, although representative of the tactical task domain, is perhaps too restricted for direct application of the data generated by this research. It is believed though, that the derived data offer significant trend information and demonstrate useful classifications and formats for taxonomic data structures. The data output of the system has been shown to be consistent with information derived externally to the system through flying experience and intuition. The application of the taxonomy has yielded answers which appear to be logical conclusions to some unknown questions. Thus, the taxonomy system is seen as a viable concept.

At this point, further paper-and-pencil research is less a requirement than an attempt to validate these concepts against real-world situations. Validation had already been done to a small degree with the UPT taxonomy; however, with the horizon of applications greatly enlarged, validation is required in order to further verify the data points generated in this research. The next step in taxonomic research of flying training should be validation with the real world by empirical measurement of the logically derived methodologies from the data system itself.

REFERENCES

Meyer, R.P., Laveson, J.I., Weissman, N.S., & Eddowes, E.E. Behavioral taxonomy of undergraduate pilot training tasks and skills: executive summary. AFHRL-TR-74-33 (I) AD-A008 771. Williams AFB, AZ: Flying Training Division, Air Force Human Resources Laboratory, December 1974.

Meyer, R.P., Laveson, J.I., Weissman, N.S., & Eddowes, E.E. Behavioral taxonomy of undergraduate pilot training tasks and skills: surface task analysis, taxonomy structure, classification rules and validation plan. AFHRL-TR-74-33 (II), AD-A000 053. Williams AFB, AZ: Flying Training Division, Air Force Human Resources Laboratory, July 1974.

Meyer, R.P., Laveson, J.I., Weissman, N.S., & Eddowes, E.E. Behavioral taxonomy of undergraduate pilot training tasks and skills: taxonomy refinement, validation and operations. AFHRL-TR-74-33 (III), AD-A008 201. Williams AFB, AZ: Flying Training Division, Air Force Human Resources Laboratory, December 1974.

Meyer, R.P., Laveson, J.I., Weissman, N.S., & Eddowes, E.E. Behavioral taxonomy of undergraduate pilot training tasks and skills: guidelines and examples for taxonomy application in flying training research. AFHRL-TR-74-33 (IV), AD-A008 897. Williams AFB, AZ: Flying Training Division, Air Force Human Resources Laboratory, December 1974.

GLOSSARY

Anticipate - the mental activity which occurs prior to a particular portion or segment of a task and triggers the decision process for a number of subsequent task sequences.

Aural - cues or stimuli which can be sensed through hearing.

Basic Skill - the significant pattern of activity contained within a single cues, mental action and motor action sequence of the surface analysis.

Classification Hierarchy - the ranking of the adopted classification rules in successive order according to the number of sorting variables contained in each rule, graduating from the fewest choices to the largest number of choices.

Classification Instructions - the concise set of regulations which determined the application of each classification rule to information described in each task sequence within the surface analysis.

Classification Matrix Board - the board upon which the taxonomic hierarchical system of basic divisions, sub-blocks and sorting slot divisions was developed for the orderly categorization of classified skill information.

Classification Rules - the set of nine guidelines adopted in this study which were used to establish the behavioral element categories for the cues, mental action and motor action components of the surface task analysis.

Control - a device used by a pilot in operating an airplane.

Control Feedback - cues or stimuli which can be sensed by body limbs or extremities through the control devices of the aircraft. The control feedback input has been shortened to Control in the cues column of the surface analysis.

Coordinate - the movement or use of two or more controls in their proper relationship to obtain a desired effect.

Coordinated Outputs - those control actions which were performed simultaneously in the motor action description of the surface task analysis.

Cue - environmental or system stimuli which excite the sensory systems of the human body.

Data Notation Card - the notation form designed to hold the coded behavioral information of an individual task sequence as determined by the behavioral element categories within the classification rules. The card is also called a skill card in the text because of the coded basic skill information it contains.

Determine - the mental activity which occurs in the problem solving and decision making process.

Discerns - the mental activity which occurs with the recognition of a specific cue.

Effector Output - pilot motor action in terms of control exerted on the aircraft, (i.e. stabilator movement resulting from control stick movement to change aircraft pitch attitude).

Long Term Memory - information which was acquired prior to the performance of the skill.

Maneuver - any planned motion of the aircraft in the air or on the ground.

Matrix Sub-Block - that portion of the classification matrix made up of 20 sorting slots which specifically categorized all skills with respect to cue kind, cue complexity, and motor action complexity rules, and provided the framework for the further isolation of skills into basic skill groups.

Memory Recall Processing - the mental action involving the recollection of procedures or facts about the performance of a task prior to performing it.

Mental Action - cognitive process initiated by perceived stimulus cues and preceding motor actions.

Motion - cues or stimuli which can be sensed by the body receptors as a result of aircraft movement.

Motor Action - those physical actions resulting in movement of aircraft controls.

Sequential Outputs - the control actions which are performed in uninterrupted succession to one another.

Short Term Memory - information remembered which was obtained during the performance of a skill.

Skill - all the behavioral activity required for the accomplishment of a specific task in real time within the tolerances of prescribed criteria.

Sorting Slot - the grouping area within the classification matrix sub-block which categorizes skill data with respect to Motor Output, Input Index, and Input/Output Index rules.

Specific Cue Processing - the mental action dealing with the perception and recognition of a specific cue and related to the use of short term memory storage.

Surface Task Analysis - a systematic description of an interaction between surface elements (i.e., cue, motor action, and the depth element, mental action) as they relate to the environment, the criteria, and the system.

Sustain - the mental activity which maintains a task segment in which the cue parameters remain constant.

Task - a group of related work elements performed in close temporal proximity by one person and directed toward the accomplishment of a definable goal.

Task Element - the smallest part of the surface analysis which is expressed as a major input or action heading; i.e., cues or mental actions or motor actions are task elements of the analysis.

Task Sequence - a complete set of interacting behavioral elements (i.e., cues, mental action, and motor action) found in the surface task analysis.

Taxonomy - a manner of classifying, and the rules and principles concerned with classification of phenomena in such a way that a more useful relationship can be established among them.

Visual - cues or stimuli which can be sensed by the eye.

APPENDIX A

AIR-TO-AIR/AIR-TO-GROUND BROAD SCOPE ANALYSIS

AIR-TO-AIR/AIR-TO-GROUND BROAD SCOPE ANALYSIS

The initial purpose for a generalized analysis of the air-to-air and air-to-ground representative tasks was an attempt to quantify the basic differences between these two groups of tactical maneuvers. It was anticipated that the methodology development and resulting data from this effort would lead to a better understanding of these maneuver groups. The first question was, "What is the difference between air-to-air and air-to-ground tasks?" The broad scope analysis was concerned with two questions: how are the two groups different, and where are they the same. Both questions were considered important to acquiring a better understanding of these tasks and then putting this understanding into practice.

The taxonomy system was seen to be an ideal tool to gain insight into these problem areas. The taxonomy is a classification system which, in this usage, categorizes behavioral characteristics together into groups or clusters. These groups may again be organized into sub-groups, which can be compared for similar or dissimilar characteristics for a general understanding. The system is likewise suited to the comparison of single behavioral characteristics on a one-to-one basis or one single characteristic to an entire group. With these possibilities, it was necessary to develop methodologies which would allow not only a general look at the skills within the air-to-air and air-to-ground flying tasks, but also those which would apply to more specific problems.

The Task Profile - It was determined that in order to establish a point of departure, skill information should be summarized into a single format. This overview information or profile would require a breakdown technique. This was accomplished by utilizing the nine behavioral categories developed for the taxonomy classification structure. Table A-1 shows a task profile of the High Dive Bomb maneuver as a typical format. Pertinent information has been organized according to the already established behavioral element categories which will allow quantitative visibility for the entire task. Appendix C contains a profile for all sixteen air-to-air and air-to-ground tasks.

Task Profile Analysis - After a number of iterations, it was determined that the most effective analysis methodology would be to investigate each classification rule separately and then to organize the resulting information into a discussion of each. These data could then be summarized relative to each task, with broad conclusions drawn for the air-to-air and air-to-ground task groups.

Table A-1. Task Profile of the High Dive Bomb

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
		freq.	MC		freq.		V-1
V	1-C	30 1	28	CP	45 2	Ai - 11 | Tr - 3	3
0	0	35 5		34	55 1	St | St	
		40 4			60 1		
		45 9	MC(I)		70 4	Th - 4	V-2
		50 8	4		80 2	St	24
		55 6		SP	90 7		
VA 0		60 3		6	100 4	Ai | St - 3	
VC 6	2-C	65 1	MR(I)		110 3	Ru | Th	
VM 0	6	70 2	6		120 1		
		75 1			130 1	Ai - 5	V-3
					140 1	Ru	0
				CONT.	175 1	St	
VAC 7			SC		200 2		
VAM 0	3-C		0		220 1	Ai - 4	V-4
VCM 10	17			A	250 4	St	2
			SC(I)	24	275 1	Ru	
			0		280 1		
					300 2	Ai | - 6	
					375 1	Ru | St	
						Ai	V-5
VACM	4-C		I	R		St | Th - 1	11
17	17		2	16		Ru	
						St - 3	
		aver. 49			aver. 143		

Cues Kind and Quantity - Tables A-2 and A-3 show the comparison of the major cue areas presented to the pilot in air-to-air and air-to-ground tasks. It should be pointed out that the Cues Kind column gives the possible major cues combination where V means Visual, A means Aural, C means Control, and M means Motion cues. For example, it can be seen that 152 of 191 skills in air-to-air tasks present some kind of Visual, Aural, Control, and Motion cues to the pilot. This compares with only 128 of 284 air-to-ground skills containing these combinations. Air-to-ground tasks have flying skills with a wider diversity of cues presentation, whereas air-to-air tasks contain skills with a complete complement of cues present. A comparison of cues quantity shows this rather graphically. Tables A-4 and A-5 show that, although neither task group contains only visual cues, the air-to-ground tasks show a rather consistent increase in the cue kinds from two through four cues. Air-to-air tasks show only a scattering of two and three cue kinds with a consistent concentration of visual, aural, control, and motion cues.

Table A-2. Air-to-Air Cues Kind Data

CUES KIND	CR-1a Single Turn Conv.	CR-2a Reattack	CR-3a Reversal	CR-4a Counter Reversal	CR-5a Low Yo-Yo	CR-6a Counter Low Yo-Yo	CR-7a High Yo-Yo	CR-8a Counter High Yo-Yo	CR-9a Racetrack DART	
V	0	0	0	0	0	0	0	0	0	0
VA	0	0	0	0	0	0	0	0	0	0
VC	2	0	0	0	0	0	1	2	2	7
VM	0	0	0	0	1	0	0	0	0	1
VAC	5	4	0	0	1	0	1	1	5	17
VAM	0	0	0	0	0	0	0	0	0	0
VCM	6	0	2	3	1	1	1	0	0	14
VACM	19	19	16	15	15	16	16	16	20	152

Table A-3. Air-to-Ground Cues Kind Data

CUES KIND	CR-1g High Dive Bomb	CR-2g High Dive Toss	CR-3g Pop-Up	CR-4g Low Angle Strafe	CR-5g Nuclear LADD	CR-6g Low Angle Dive Bomb	CR-7g 30° Dive Rockets	
V	0	0	0	0	0	0	0	0
VA	0	0	0	0	0	0	0	0
VC	6	6	6	5	7	5	6	41
VM	0	0	0	0	0	0	0	0
VAC	7	7	6	7	7	6	7	47
VAM	0	1	0	0	0	0	0	1
VCM	10	9	11	10	5	10	12	67
VACM	17	18	30	17	12	18	16	128

Table A-4. Air-to-Ground Cues Quantity Data

QUANTITY	CR-1g High Dive Bomb	CR-2g High Dive Toss	CR-3g Pop-Up	CR-4g Low Angle Strafe	CR-5g Nuclear LADD	CR-6g Low Angle Dive Bomb	CR-7g 30° Dive Rockets
1-C	0	0	0	0	0	0	0
2-C	6	6	6	5	7	5	6
3-C	17	17	17	17	12	16	16
4-C	17	18	30	17	12	18	16

Table A-5. Air-to-Air Cues Quantity Data

QUANTITY	CR-1a Single Turn Conv.	CR-2a Reattack	CR-3a Reversal	CR-4a Counter Reversal	CR-5a Low Yo-Yo	CR-6a Counter Low Yo-Yo	CR-7a High Yo-Yo	CR-8a Counter High Yo-Yo	CR-9a Racetrack DART
1-C	0	0	0	0	0	0	0	0	0
2-C	2	0	0	0	1	0	1	2	2
3-C	11	14	2	3	2	1	2	1	5
4-C	19	19	16	15	15	16	16	16	20

Cues Input Index - This index expressed a percentage relationship between the number of cues available under each major cue heading and the total number of cues possible. The index was designed to express the load of cues a pilot must sort out to successfully perform each skill in the taxonomy. The highest cues loading per skill was 75 and the lowest was 20. The distribution of cues load information can be seen in each task profile in Appendix C. Tables A-6 and A-7 show the average of the index for each air-to-air and air-to-ground task. It can be seen that air-to-air tasks have a greater range of cues loading, from 40 to 55 and a higher mean output average. Air-to-ground tasks have a lower mean output of 46 and generally more consistency between tasks. It should be noted, however, that the Nuclear LADD and the Pop-Up break with this consistency, perhaps because they are both low level tasks.

Table A-6. Air-to-Air Cues Input Index Data

	CR-1a Single Turn Conv.	CR-2a Reattack	CR-3a Reversal	CR-4a Counter Reversal	CR-5a Low Yo-Yo	CR-6a Counter Low Yo-Yo	CR-7a High Yo-Yo	CR-8a Counter High Yo-Yo	CR-9a Racetrack DART
INPUT aver.	40	51	49	46	52	48	52	49	55

Table A-7. Air-to-Ground Cues Input Index Data

	CR-1g High Dive Bomb	CR-2g High Dive Toss	CR-3g Pop-Up	CR-4g Low Angle Strafe	CR-5g Nuclear LADD	CR-6g Low Angle Dive Bomb	CR-7g 30° Dive Rockets
INPUT aver.	49	48	43	43	41	47	49

Information Processing - The continuing mental activity can be illustrated as it relates to how the pilot utilizes information (cues) from the flying environment. The six informational mental actions are Multi-Cue or MC, Multi-Cue/Iterative or MC(I), Memory Recall/Iterative or MR(I), Specific Cue or SC, Specific Cue/Iterative or SC(I), and Iterative or I processing. These terms are discussed in Volume II of this research; however, in general it should be remembered that these mental processes are listed in declining order of difficulty and complexity. The air-to-air and air-to-ground comparisons shown in Tables A-8 and A-9 indicate that the skills of both flying task areas contain a high percent of Multi-Cue processing: 83 percent for air-to-air and 79 percent for air-to-ground tasks. Considerably more Memory Recall/Iterative processing was involved in air-to-ground tasks. This mental action occurred in the planning or anticipation of skill groups within a task. It can be concluded from this, that air-to-ground tasks require a pilot to establish a more well defined mental set than do most air-to-air tasks. It can also be seen that there is a great amount of Specific Cue, SC, processing in air-to-air. It is not surprising, particularly in these well controlled training tasks, that only a specific target should engross the pilot's attention. A more combat oriented environment would probably alter this data.

Decision Process - This mental action determined whether a decision which resulted from the assimilation of flying information resulted in a Simple or Complex Processing. Simple Processing, SP, was considered to be a decision based on a specific cue or fact whereas Complex Processing was based on the estimation or interpretation of cues and facts.

Table A-8. Air-to-Air Information Processing Data

INFO. PROCESS	CR-1a Single Turn Conv.	CR-2a Reattack	CR-3a Reversal	CR-4a Counter Reversal	CR-5a Low Yo-Yo	CR-6a Counter Low Yo-Yo	CR-7a High Yo-Yo	CR-8a Counter High Yo-Yo	CR-9a Racetrack DART
MC	17	13	13	12	15	9	14	11	20
MC(I)	1	6	3	2	0	4	0	1	3
MR(I)	3	2	1	1	3	1	2	2	4
SC	4	2	1	1	0	0	1	1	0
SC(I)	3	0	0	0	0	2	1	3	0
I	4	0	0	2	0	1	1	1	0

Table A-9. Air-to-Ground Information Processing Data

INFO. PROCESS	CR-1g High Dive Bomb	CR-2g High Dive Toss	CR-3g Pop-Up	CR-4g Low Angle Strafe	CR-5g Nuclear LADD	CR-6g Low Angle Dive Bomb	CR-7g 30° Dive Rockets
MC	28	29	36	26	19	26	28
MC(I)	4	3	3	6	1	6	6
MR(I)	6	7	8	6	4	6	7
SC	0	0	1	0	2	0	0
SC(I)	0	0	3	0	5	0	0
I	2	2	2	1	0	1	1

Tables A-10 and A-11 show the comparisons between air-to-air and air-to-ground tasks. It can be seen that most skills in both air-to-air and air-to-ground tasks required complex decisions. The relationship of Simple versus Complex decision processing held relatively constant among tasks. Notable exceptions were the Nuclear LADD in air-to-ground and the Single Turn Conversion in air-to-air tasks.

Table A-10. Air-to-Air Decision Processing Data

DECISION PROCESS	CR-1a Single Turn Conv.	CR-2a Reattack	CR-3a Reversal	CR-4a Counter Reversal	CR-5a Low Yo-Yo	CR-6a Counter Low Yo-Yo	CR-7a High Yo-Yo	CR-8a Counter High Yo-Yo	CR-9a Racetrack DART
CP	18	21	16	15	18	15	17	16	24
SP	14	2	2	3	0	2	2	3	3

Table A-11. Air-to-Ground Decision Processing Data

DECISION PROCESS	CR-1g High Dive Bomb	CR-2g High Dive Toss	CR-3g Pop-Up	CR-4g Low Angle Strafe	CR-5g Nuclear LADD	CR-6g Low Angle Dive Bomb	CR-7g 30° Dive Rockets
CP	34	35	36	34	21	32	34
SP	6	5	3	5	10	7	7

Input/Output Index - This behavioral element category concentrated on the observable input to and output from the mental activity. Since this category is accomplished by utilizing both cues and motor actions, it becomes a measure of both knowledge and skill - thus, a measure of initial skill difficulty. The basic data from Air-to-Air Task Profiles range from 30 to 350 with 151 as a mean group average. Air-to-Ground Task Profiles range from 20 to 375, with 136 as a mean group average. Tables A-12 and A-13 bear out this information. It can be seen that the average task input/output index is considerably higher in air-to-air than in air-to-ground tasks. Again, air-to-ground tasks are quite consistent with the exception of the Nuclear LADD. Air-to-air tasks show a larger range which would indicate that the initial difficulty of the tasks is much greater in some than in others. Since initial difficulty is what a student first encounters in performing a task, these data have significance for the training specialist.

Table A-12. Air-to-Air Input/Output Index Data

	CR-1g High Dive Bomb	CR-2g High Dive Toss	CR-3g Pop-Up	CR-4g Low Angle Strafe	CR-5g Nuclear LADD	CR-6g Low Angle Dive Bomb	CR-7g 30° Dive Rockets
INPUT/ OUTPUT aver.	134	145	125	142	119	141	139

Table A-13. Air-to-Ground Input/Output Index Data

	CR-1a Single Turn Conv.	CR-2a Reattack	CR-3a Reversal	CR-4a Counter Reversal	CR-5a Low Yo-Yo	CR-6a Counter Low Yo-Yo	CR-7a High Yo-Yo	CR-8a Counter High Yo-Yo	CR-9a Racetrack DART
INPUT/ OUTPUT aver.	125	187	126	131	191	141	164	141	161

Task Continuity - This behavioral element provided important information about the progression of each skill within a task with respect to the skills which preceded and followed it in the sequence. This category pertains to the dynamic quality of the flying tasks. It illustrates whether the pilot is attempting to establish or maintain an Attitude, (A), or to establish a Rate, (R), of attitude change. The comparative information in Tables A-14 and A-15 shows the number of each of these behavioral requirements for each task. It was determined that a rate of attitude

Table A-14. Air-to-Air Continuity Data

CONT.	CR-1a Single Turn Conv.	CR-2a Reattack	CR-3a Reversal	CR-4a Counter Reversal	CR-5a Low Yo-Yo	CR-6a Counter Low Yo-Yo	CR-7a High Yo-Yo	CR-8a Counter High Yo-Yo	CR-9a Racetrack DART
A	14	3	9	9	8	11	4	12	9
R	18	15	9	9	10	6	15	7	18

Table A-15. Air-to-Ground Continuity Data

CONT.	CR-1g High Dive Bomb	CR-2g High Dive Toss	CR-3g Pop-Up	CR-4g Low Angle Strafe	CR-5g Nuclear LADD	CR-6g Low Angle Dive Bomb	CR-7g 30° Dive Rockets
A	24	23	32	24	16	24	22
R	16	18	21	15	15	15	19

change was a more complex achievement than the establishment of an attitude, even for an experienced pilot. This behavioral element category is also a measure of task and skill difficulty. It can be seen by studying the continuity comparison tables that, in general, air-to-air tasks contain a considerably higher proportion of rate attitude changes than do air-to-ground tasks. This is not surprising; however, it does indicate a difference in skill requirements and a measure of difficulty level between the two task groups.

Motor Output and the Output Index - These two element categories are closely related and therefore will be discussed together. The control outputs shown in the Task Profiles are directed to flight controls or effector outputs only. This decision, then, deals only with motor actions which essentially put the aircraft in a required position in the sky.

It was considered important to assess the air-to-air and air-to-ground tasks in this way to determine whether there were basic differences between the two groups in terms of handling the aircraft. Table A-16 shows the kinds and combinations of control output for each group. Coordinated controlling is shown by this bracket symbology, $\{$, and successively performed outputs are shown with a vertical bar symbol, $|$. For example: the $\begin{cases} \text{Ai} \\ \text{Ru} \end{cases} \Big| \begin{matrix} \text{St} \\ \text{Th} \end{matrix}$ notation illustrates a coordinated Aileron (Ai) and Rudder (Ru) combination with successively performed Stabilator (St) and Throttle (Th) movement. It can be seen that eight different effector outputs constitute the majority for both groups: 94 percent for air-to-air tasks and 97 percent for air-to-ground tasks. Table A-17 shows a comparison of air-to-air and air-to-ground effector outputs ranked according to percentage of frequency. This table clearly shows that there are some differences in aircraft handling which are reflected in behavioral characteristics; however, these are not as great as might have been presumed.

The Output Index - This index completes the task profile. This category identified the amount of motor activity taking place within an individual skill in a task. Five Value (V) areas are identified in this index as follows:

V-1 One output
V-2 Two or more successively performed outputs
V-3 Two coordinated outputs
V-4 More than two coordinated outputs
V-5 Coordinated and successively performed outputs

Table A-16. Air-to-Air and Air-to-Ground Effector Output Data

Air-to-Air Tasks

Rank	Effector Output	No.	%
1.	{Ai, Ru | St}	55	29
2.	| Ai, St	45	24
3.	| Ai, Ru, St	44	22
4.	St	15	7
5.	{Ai, Ru, St}	7	4
6.	{Ai, Ru | St, Th}	7	4
7	| Th St, Ai Ru	3	2
8.	| Tr, St	3	2
9.	| Th, St.	2	1
10.	{Ai, Ru, St | Th}	2	1
11.	| St, Ru	2	1
12.	| Th, Tr, St	1	
13.	Th	1	
14.	{Ai, Ru | Th}	1	
15.	{Ai, Ru, St | Tr}	1	
16.	{Ai, Ru | St, Tr}	1	
17.	| Ai St, Ru Ru	1	

Air-to-Ground Tasks

Rank	Effector Output	No.	%
1.	| Ai, St	75	25
2.	{Ai, Ru | St}	54	18
3.	| Ai, Ru, St	44	14
4.	St	27	10
5.	{Ai, Ru | St, Th}	21	7
6.	| Tr, St	20	7
7.	| Th, St	16	6
8.	{Ai, Ru, St}	12	5
9.	{Ai, Ru, St | Th}	3	2
10.	| Ai St, Ru Tr	2	1
11.	{Ai, Ru | St, Tr}	2	1
12.	| Th, Tr, St	2	1
13.	| Ai St, Ru Th	2	1
14.	| Ai, Ru	1	
15.	| St, Ru	1	

Table A-17. Air-to-Air and Air-to-Ground Effector Output Rank Comparison

Air/Air Rank	Air/Gr. Rank	Effector Output
1.	2.	Ai, Ru | St
2.	1.	Ai | St
3.	3.	Ai, Ru | St
4.	4.	St
5.	9.	Ai, Ru, St
6.	6.	Ai, Ru | St, Th
7.	None	Ai, Th | St, Ru
8.	8.	Tr | St
9.	5.	Th | St
10.	11.	Ai, Ru, St | Th
11.	16.	St | Ru
12.	12.	Th, Tr | St
13.	13.	Ai | Ru
None	14.	Ai | St
15.	15.	Ai, Ru | St, Tr
16.	None	Ai, Ru, St | Tr
17.	None	Ai, Ru | Th

Tables A-18 and A-19 show a comparison of the control activity for the tasks in the air-to-air and air-to-ground groups. It can be seen that the amount of motor activity is proportioned quite evenly; thus, air-to-air and air-to-ground skills contain a similar level of motor activity.

Table A-18. Air-to-Air Output Index Data

OUTPUT INDEX	CR-1g High Dive Bomb	CR-2g High Dive Toss	CR-3g Pop-Up	CR-4g Low Angle Strafe	CR-5g Nuclear LADD	CR-6g Low Angle Dive Bomb	CR-7g 30° Dive Rockets	
V-1	3	2	5	3	4	2	3	22
V-2	24	25	31	23	18	24	25	170
V-3	0	0	0	0	0	0	0	0
V-4	2	1	1	1	0	0	4	9
V-5	11	13	16	12	9	13	9	83

Table A-19. Air-to-Ground Output Index Data

OUTPUT INDEX	CR-1a Single Turn Conv.	CR-2a Reattack	CR-3a Reversal	CR-4a Counter Reversal	CR-5a Low Yo-Yo	CR-6a Counter Low Yo-Yo	CR-7a High Yo-Yo	CR-8a Counter High Yo-Yo	CR-9a Racetrack DART	
V-1	3	0	0	0	1	2	2	2	1	11
V-2	16	11	14	13	7	9	9	11	17	107
V-3	0	0	0	0	0	0	0	0	0	0
V-4	0	2	0	0	1	0	2	0	1	6
V-5	13	10	14	5	9	6	6	6	8	77

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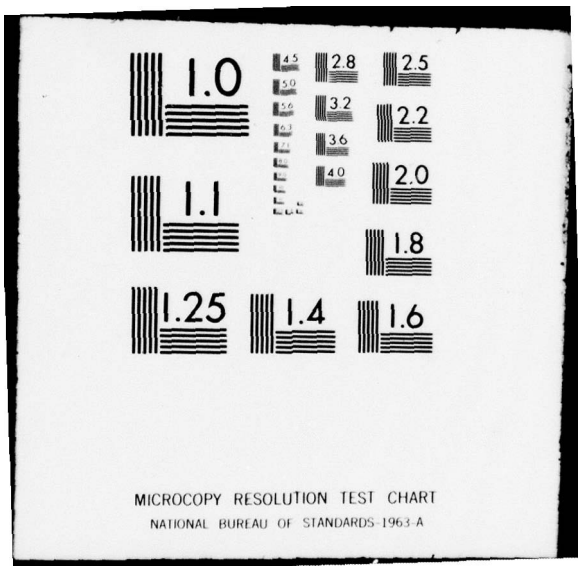
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Task/Skill Distribution Within Representative Tactical Flying Tasks - It has been shown that the taxonomic system can be used as an important comparison tool. The Task Profiles presented broad data which can give insight into various tasks and task groups. The task/skill distribution system, however, can deal in specific comparisons.

Task/Skill Distribution - In order to formulate a true building block approach to flying training, it will be necessary to be able to compare the skills of one task to the skills of a group of tasks. In this way similar and dissimilar relationships can be determined and this information used to formulate more integrated learning programs. The taxonomy has broken down each task into element sequences. These sequences (each consisting of a cues, mental action and resulting motor action) are the basic skills within each task. The classification of these basic skills into a matrix system according to specific behavioral characteristics has made it possible to bring identical basic skills together across tasks. Table A-20 shows the results of this capability. It shows the task/skill distribution within the High Yo-Yo air-to-air task. The center column of the table is divided into the basic skills and the sorting slot into which the classification rules have placed it within the matrix system. Basic skills of identical characteristics from tasks of a prescribed data base are, thus, also clustered within a specific sorting slot. These skills are shown in the right-hand and left-hand columns of Table A-20. For example, skill 5a(A) in the left-hand column is the first skill in the sequence of the Low-Yo-Yo and is identical to skill "A" of the High Yo-Yo. Skill 8a(B)* in the left-hand column is designated with an asterisk because it is a kindred skill. Underlined skills are from the High Yo-Yo which have an internal relationship with another skill within this task.

The Identification of Kindred Skills - In the process of sorting the basic skills into groups having identical behavioral characteristics, it was determined that certain other skills were closely related, though not necessarily identical. This led to the establishment of a class of kindred skills. Several rather simple rules were established in order to add this dimension to skill sorting.

1. Kindred skills must be found in the same sorting slot as the verified identical skills.
2. Kindred skills must contain the same kind and number of major cues as the verified identical skills.

Table A-20. Task/Skill Distribution Within the High Yo-Yo

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
8a(B)*, 5a(A)	A-327	2g(O)*, 3g(N)*, 4g(C)*, 1g(P)*, 2g(C)*, 6g(C)*
	B-275	
7a(N)*, 9a(Y)*	C-280	
1a(U)	D-200	3g(T)*
7a(L)*, 2a(I), 2a(K)	E-279	5g(O), 7g(X), 7g(Y)
6a(O)*	F-256	6g(HH), 3g(VV)*, 7g(M)* 1g(M)*
4a(O)*, 5a(K)*, 5a(F), 9a(M)	G-337	4g(U), 3g(FF)*, 4g(II)* 1g(W)*, 3g(S)*
2a(U), 3a(I), 5a(C), 5a(G), 5a(L), 5a(N)	H-280	2g(S), 4g(R), 4g(V), 6g(Q), 6g(U)
7a(J)*, 1a(DD)*	I-277	
7a(I)*, 1a(DD)*	J-277	
5a(M)*, 9a(S), 9a(L)	K-276	3g(BB)*, 3g(KK)*, 5g(I)*, 4g(HH)*, 5g(I)*
7a(E)*, 2a(I)*, 2a(K)*	L-279	1g(X)*, 7g(X)*, 7g(Y)*
5a(O), 6a(N), 9a(AA)	M-280	3g(HH), 5g(CC)
7a(C)*, 9a(Y)*, 5a(O)*, 6a(N)*, 7a(M)*, 9a(AA)*	N-280	3g(HH)*, 5g(CC)*
	O-17	2g(OO), 6g(MM), 1g(NN)*, 5g(F)*
	P-392	
5a(I)*, 1a(D), 3a(L), 3a(M)	Q-277	3g(MM)
	R-277	
	S-477	

3. Kindred skills must contain the same information and decision processing, motor output, and output index as the verified identical skills.
4. Kindred skills will be allowed a plus or minus ten in the input index. A related variation will likewise be allowed in the input/output index since these two categories are related.

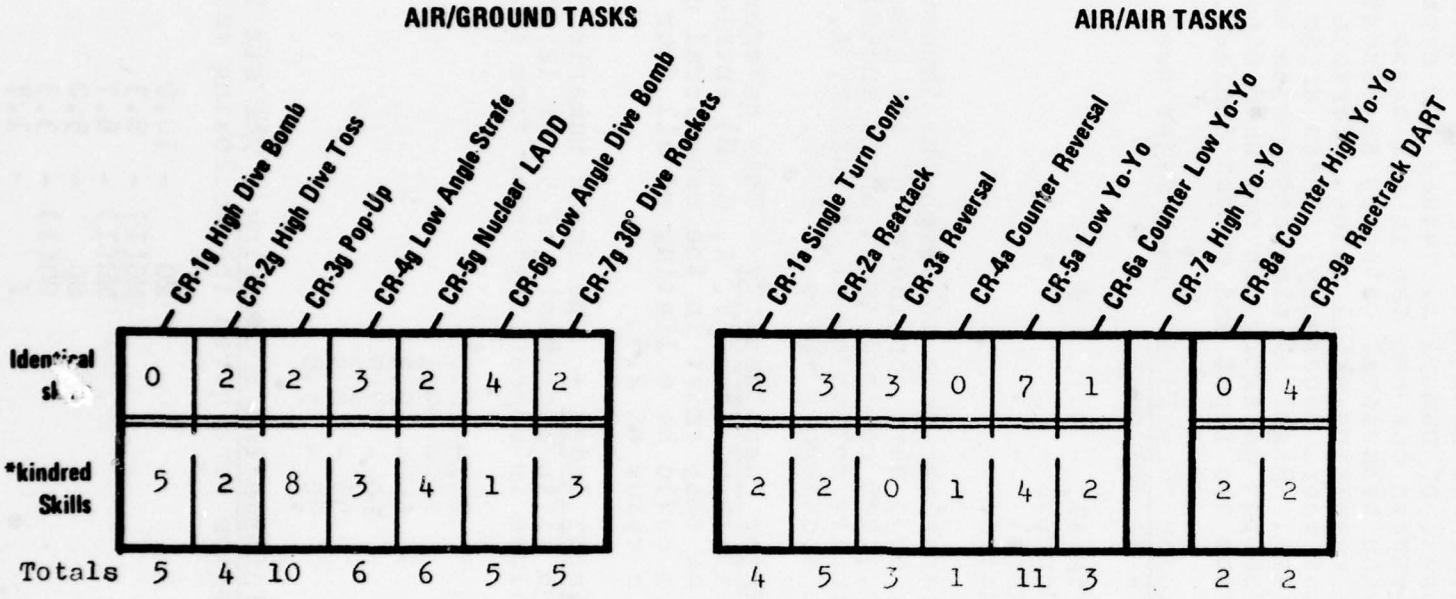
It was, thus, established that kindred skills had a positive learning transfer to identical skills. Table A-21 shows a numerical breakdown of identical and kindred skills associated with the High Yo-Yo. As can be seen, the identical skills have precedence over kindred skills in the determination of skill relationships between one task and another. The totaling of identical and kindred skills in Table A-21 is useful to generalize skill trend information.

Appendix D contains task/skill distribution information for each representative tactical task. Specific study of this information shows that, in general, air-to-air skills contain a proportionally large complement of air-to-ground skills. Conversely, air-to-ground skills in general contain only a scattering of air-to-air skills.

Skill Difficulty Analysis - The taxonomy has been used as a comparison tool; however, an attempt was made to utilize taxonomic information for related and more specific purposes. The Task Profile described earlier in this section provided insight into a methodology for the development of a task/skill difficulty index for the sixteen representative tasks. In order to accomplish this, it was first necessary to analyze each skill in a task and arrive at a difficulty value at the basic level. The nine behavioral categories used for the taxonomic classification and task profile descriptions became the basis upon which an individual skill difficulty value would be predicated.

One of the problems confronting researchers was to devise a set of rules for the determination of difficulty which would be completely objective and quantitative in nature. Rules derived from an established set of straightforward behavioral characteristics developed for the taxonomic classification proved to be a useful starting point. Further investigation also proved that numerical values could be attached to individual elements within each behavioral category. The sum of each behavioral element category would produce a value for each basic skill in a task. The summation and averaging of each skill value produced a difficulty index for each task.

Table A-21. Tasks Containing Skills Identical and Kindred to the High Yo-Yo



Task/Skill Difficulty Rules Rationale - The following are rules and rationale for each behavioral element category. The spread of numerical values for each category has been kept between one and ten in all cases. This was done to give each behavioral category an essentially equal impact on the resulting skill value. Certain areas have been weighted where necessary. These areas have been described in detail. Eight of nine categories have been used. The input/output category was not used since it already combined data from the input and output indices.

Major Cues Kind - Each major cues area has been given a value as follows:

Visual - 4
Control - 3
Aural - 2
Motion - 1

An attempt was made to weigh the importance of a cue area. Visual cues were considered of the greatest importance in flying, then control, next aural including communication, and finally motion cues. A full V, A, C, M complement yields a category value of 10.0.

Major Cues Quantity - This category contains the possibility of four (V, A, C, M) entries. These are simply noted as they exist in the behavioral category. Since the maximum could be a listing of all four major cues, each was given a value of 2.5.

Input Index - The input numerical spread is from 20 through 75 in increments of 5, or 12 spaces. The following are values in descending order from 10.0:

75 - 10.0	45 - 5.0
70 - 9.1	40 - 4.2
65 - 8.3	35 - 3.3
60 - 7.5	30 - 2.5
55 - 6.6	25 - 1.6
50 - 5.8	20 - .8

Information Processing - The six information processing categories were given the following values:

MC - 10.0
MC(I) - 8.3
MR(I) - 6.7
SC - 5.0
SC(I) - 3.3
I - 1.7

The six mental processes were ranked in terms of complexity with Multi-Cue, MC, processing considered the most complex, ranging down to Iterative, I, processing as the least complex. Each increase in difficulty level raised the next value by 1.66 until the Multi-Cue, MC, processing received a value of 10.0.

Decision Processing - This category contains only two possible entries - Simple or Complex Processing. The Complex Processing, CP, was given a maximum value of 10.0. The Simple Processing, SP, was weighted to a value of 6.0 intuitively since even the simple mental processes in tactical flying are not considered simplistic.

Simple Processing or SP - 6.0
Complex Processing or CP -10.0

Continuity - This category contains two possibilities: establishing an aircraft attitude, A, or establishing a rate of attitude change, R. The following values were assigned:

Establishing an Attitude, or A - 7.0
Establishing a Rate of
Attitude Change, or R - 10.0

The establishment of an attitude was weighted intuitively to reflect the fact that this flying requirement was not as simple as it is sometimes considered and is more than half as difficult as the establishment of a rate of attitude change.

Motor Output - Each effector output: Aileron, Stabilator, Rudder, Throttle, and Trim are given a value of 2.0. Control discrete entries: checking and communication, are each given a value of 1.0. This value structure considers flight control twice as difficult as discrete outputs or communication in these representative tasks.

Output Index - Each index number is multiplied by 2 as follows:

Value 1 - 2.0 (1 output)
Value 2 - 4.0 (2 or more successively performed outputs)
Value 3 - 6.0 (2 coordinated outputs)
Value 4 - 8.0 (More than 2 coordinated outputs)
Value 5 -10.0 (Coordinated and successively performed outputs)

This simple straight count was used with a simple multiplication to satisfy the established scale of 10.0 as the maximum category number.

Table A-22 shows an example of the skill difficulty analysis by behavioral category. Notice that each element sequence or basic skill for the High Yo-Yo task has a specific value. These data are thus cross-referenced to the original surface task analysis and taxonomic classification system. The summation and averaging of the skill values yield the difficulty index for each task. A task/skill difficulty has been done for each of the representative air-to-air and air-to-ground tasks. These can be found in Appendix E.

Table A-23 shows a listing of the representative tasks which have been ranked in order of this difficulty as derived from this methodology. It should be noted that the air-to-ground tasks are very closely ranked with only a 4.7 difficulty spread, while air-to-air tasks have a greater 9.9 difficulty spread. The mean difficulty level for air-to-air tasks was also found to be 3.5 higher.

This information proved interesting. However, there was no evidence that pilots would agree with this difficulty ranking. For this reason, a brief survey of F-4 pilots was taken. Twenty-three Instructor Pilots (IPs) were asked to rank the seven air-to-ground tasks and the nine air-to-air tasks. Table A-24 shows the results of this brief survey. It can be seen that the difficulty index ranking held up quite well to pilots' subjective ranking among the air-to-air tasks. The difficulty index ranking did not measure up to pilots' ranking in the air-to-ground tasks. Pilots responding, however, found it more difficult to rank air-to-ground tasks. This was born out by the narrow difficulty spread shown by the difficulty index.

Broad Scope Analysis Conclusion - This analysis methodology was divided into three principal areas: (1) Task Profile Analysis, (2) Task/Skill Distribution Analysis, and (3) Analysis of Task/Skill Difficulty. Each of these analysis areas yielded information about the sixteen tactical flying tasks. The Task Profile showed a comparison of air-to-air and air-to-ground tasks by established behavioral element characteristics. This analysis showed that there are differences between the two task groups, but that these differences are not as great as might have been expected. In that regard, the generalized information showed that air-to-air tasks were more difficult with greater ranges of complexity. Conversely, air-to-ground tasks were somewhat less complex with a narrower range of complexity.

Table A-22. Task/Skill Difficulty Analysis of the High Yo-Yo

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5	2.5	6.7	10	7	4	4	46.2
B	9	7.5	2.5	10.	10	7	8	4	58.0
C	10	10.	5.8	10.	10	10	6	10	71.8
D	10	10.	6.6	10.	10	10	6	10	72.6
E	10	10.	6.6	10.	10	7	6	10	69.6
F	10	10.	5.0	6.7	10	7	4	4	56.7
G	10	10.	5.8	10.	10	10	6	10	71.8
H	10	10.	6.6	10.	10	10	6	10	72.6
I	10	10.	7.5	10.	10	10	6	4	67.5
J	10	10.	8.3	10.	10	7	6	10	71.1
K	10	10.	5.8	8.3	10	7	4	4	59.1
L	10	10.	5.8	10.	10	10	6	10	71.8
M	10	10.	7.5	10.	10	10	2	2	61.5
N	10	10.	5.8	10.	10	10	6	10	71.8
O	10	10.	7.5	10.	10	10	6	10	73.5
P	10	10.	6.6	10.	10	7	6	8	67.6
Q	10	10.	7.5	10.	10	7	7	4	65.5
R	8	7.5	6.6	10.	10	10	4	4	60.1

Task Difficulty Index
66.04

Skill Value Range
46.2 to 73.5

Table A-23. Task Difficulty Ranking

Air/Air			Air/Ground		
Task Rank	Task	Difficulty Index	Task Rank	Task	Difficulty Index
1.	Reattack	66.8	1.	Low Angle Dive Bomb	61.1
2.	Low Yo-Yo	66.0	2.	High Dive Toss	61.1
3.	DART	65.6	3.	High Dive Bomb	60.0
4.	High Yo-Yo	64.3	4.	Low Angle Strafe	59.8
5.	Reversal	64.0	5.	30° Dive Rockets	59.7
6.	Counter Low Yo-Yo	62.0	6.	Pop-Up	58.9
7.	Counter Reversal	61.5	7.	Nuclear LADD	56.4
8.	Counter High Yo-Yo	61.0			
9.	Single Turn Conversion	56.9			
	Mean	63.1		Mean	59.6
	Spread	9.9		Spread	4.7

Table A-24. Pilot Survey Ranking/Difficulty Index Ranking

Air/Air

Pilot Survey Ranking	Index Ranking
1. DART	Reattack
2. Reattack	Low Yo-Yo
3. Low Yo-Yo	DART
4. High Yo-Yo	High Yo-Yo
5. Reversal	Reversal
6. Counter Reversal	Counter Low Yo-Yo
7. Counter High Yo-Yo	Counter Reversal
8. Counter Low Yo-Yo	Counter High Yo-Yo
9. Single Turn Conversion	Single Turn Conversion

Air/Ground

Pilot Survey Ranking	Index Ranking
1. High Dive Bomb	Low Angle Dive Bomb
2. Pop-Up	High Dive Toss
3. Low Angle Strafe	High Dive Bomb
4. High Dive Toss	30° Dive Rockets
5. Low Angle Dive Bomb	Low Angle Strafe
6. 30° Dive Rockets	Pop-Up
7. Nuclear LADD	Nuclear LADD

The Task/Skill Distribution showed how skills in one task related to skills of another. A method of showing the distribution of skills across tasks was determined. The Task/Skill Distribution analysis showed that air-to-air tasks contain a high proportion of air-to-ground tasks within their structure. This information could be very important to the training specialist developing a new training program.

The Task/Skill Difficulty analysis presented a methodology for objectively determining the difficulty of each basic skill within a task. This skill difficulty data could then be summarized to yield a task difficulty index. The sixteen representative tasks were ranked according to this difficulty index. A sampling of F-4 IPs at Luke AFB was asked to rank the seven air-to-ground and nine air-to-air tasks subjectively according to difficulty. The difficulty index developed with the assistance of the taxonomy held up well with the air-to-air tasks; however, the air-to-ground tasks proved to be a less positive correlation.

This was, perhaps, due to the fact that the difficulty index showed that the representative air-to-ground tasks have a rather consistent rate of difficulty across tasks. The conclusion which can be drawn from the Task/Skill Difficulty ranking and subjective pilot ranking is that a number of other factors enter into what makes a pilot consider a task difficult. The task difficulty index, however, could prove to be one measure in the objective determination of task and skill difficulty.

APPENDIX B

TAXONOMIC SYSTEM DATA

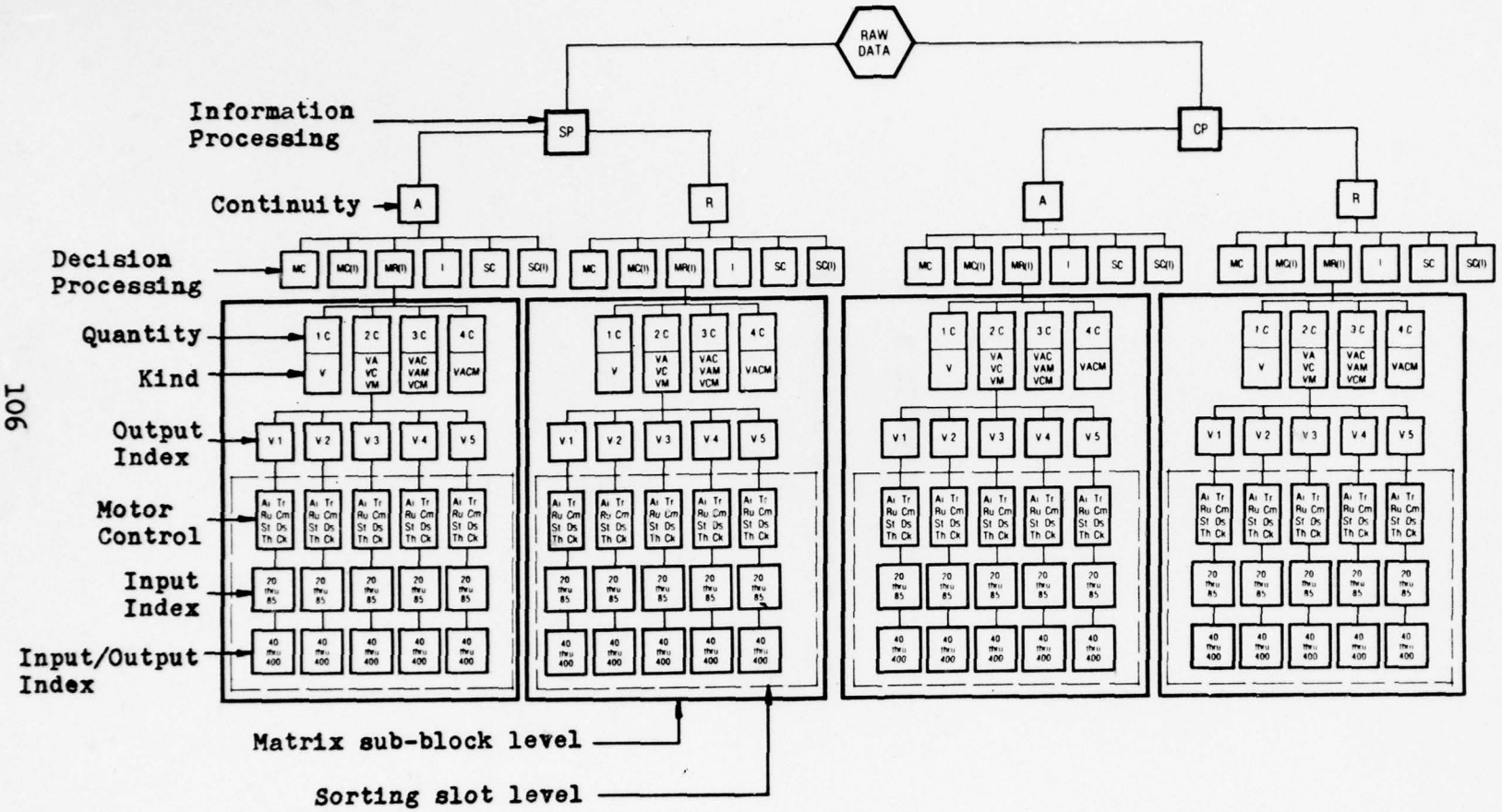


Figure B-1. Classification hierarchy.

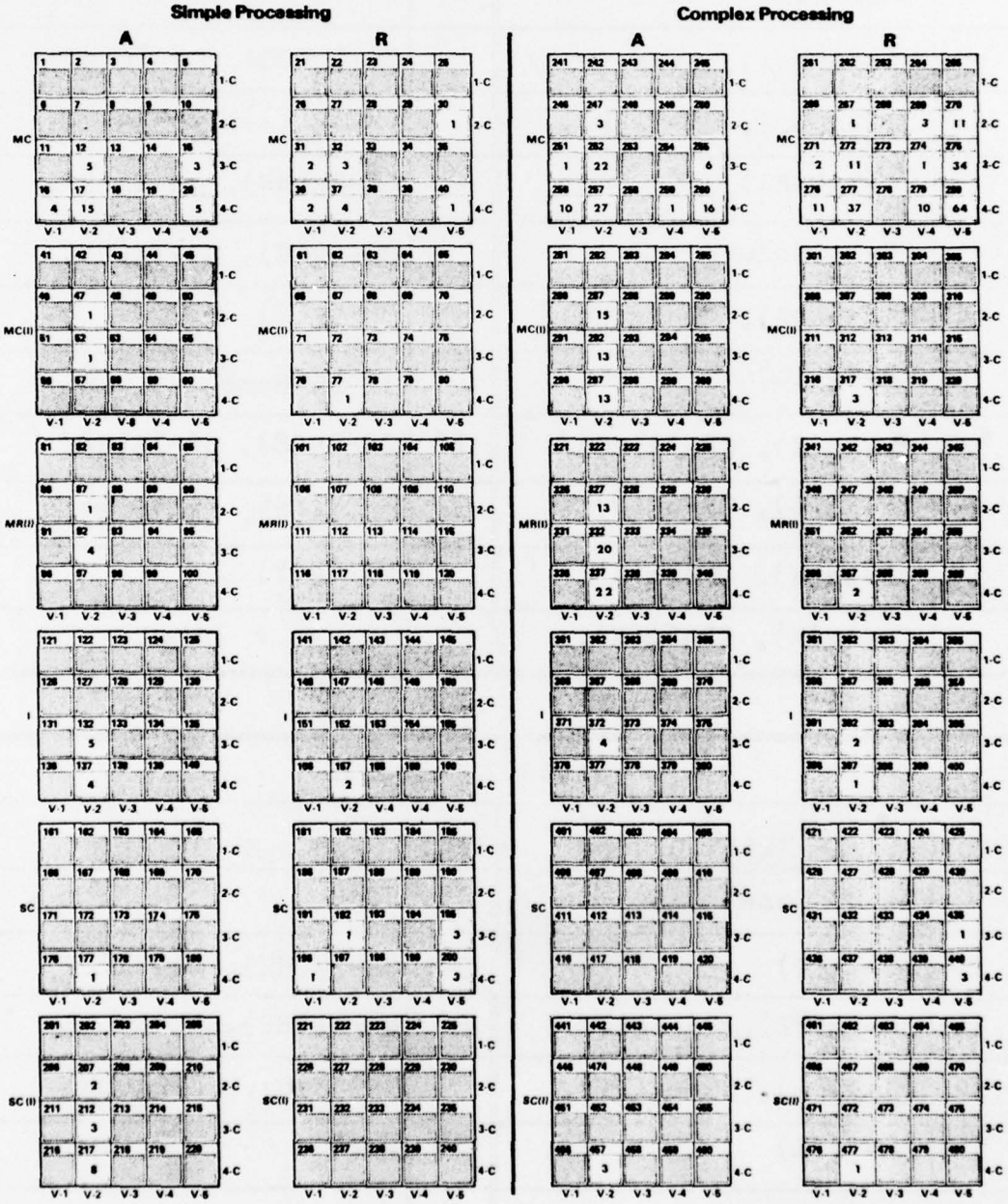


Figure B-2. Taxonomic matrix system.

SORTING SLOT CONTENTS LIST

Slots 1 thru 20			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	1-11 None	17	CR-7g(K)/ CR-7a(O),
12	/CR-3g(AAA), CR-4g(MM)/		CR-2g(OO), CR-6g(MM)/
	CR-2g(CC), CR-5g(R),		CR-1g(II), CR-7g(JJ)/
	CR-3g(AAA)		CR-1g(NN), CR-2g(X),
	13-14 None		CR-3g(V), CR-3g(NN),
15	/CR-3g(ZZ), CR-7g(NN)/		CR-5g(F)
	CR-6g(LL)		18-19 None
16	/CR-1a(K), CR-3g(CC)/	20	/CR-1a(E), CR-1a(S)/
	CR-1a(L), CR-6a(P)		CR-1a(W), CR-3g(Q),
17	/CR-1g(K), CR-2g(K),		CR-6g(F)
	CR-4g(K), CR-6g(K),		

Slots 21 thru 40			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	21-29 None	35	None
30	CR-1g(Q)	36	CR-1g(HH), CR-7g(II)
31	/CR-1g(FF), CR-4g(FF)/	37	CR-1a(EE), CR-3a(H),
32	CR-4g(L), CR-6g(FF),		CR-4a(Q), CR-2g(HH)
	CR-7g(L)	38	None
33	None	39	None
34	None	40	CR-2a(O)

SORTING SLOT CONTENTS LIST

Slots 41 thru 60			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	41-46 None	52	CR-9a(C)
47	CR-3g(A)		53-60 None
	48-51 None		

Slots 61 thru 80			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	61-76 None		78-80 None
77	CR-1g(V)		

Slots 81 thru 100			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	81-86 None	92	CR-9a(I), CR-6g(II),
87	CR-9a(B)		CR-5g(B), CR-7g(KK)
	88-91 None		93-100 None

Slots 101 thru 120			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	None		

SORTING SLOT CONTENTS LIST

Slots 121 thru 140			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	121-131 None		133-136 None
132	CR-1a(O), CR-1a(T),	137	/CR-4g(T), CR-6g(S)/
	CR-4a(A), CR-2g(AA),		CR-6a(Q), CR-8a(R)
	CR-3g(G)		138-140 None

Slots 141 thru 160			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	141-156 None		158-160 None
157	CR 1a(BB), CR-4a(I)		

Slots 161 thru 180			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	161-176 None		178-180 None
177	CR-3a(R)		

Slots 181 thru 200			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	181-191 None	195	CR-5g(Y)
192	CR-5g(C)	196	CR-1a(J)
	193-194 None		197-199 None
195	CR-1a(C), CR-2a(D),	200	/CR-1a(U), CR-7a(D)/ CR-3g(T)

SORTING SLOT CONTENTS LIST

Slots 201 thru 220			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	201-206 None	217	CR-1a(M), CR-8a(L),
207	CR-5g(A), CR-5g(T)		CR-8a(P), CR-3g(Y),
	208-211 None		CR-3g(DD), CR-3g(EE),
212	CR-1a(A), CR-1a(N),		CR-5g(AA), CR-5g(EE)
	CR-5g(X)		218-220 None
	213-216 None		

Slots 221 thru 240			
Slot	Basic Skill Groups		
	None		

Slots 241 thru 260			
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	241-246 None		248-250 None
247	/CR-1g(B), CR-4g(B)/	251	CR-5g(E)
	CR-3g(B)		
252	/CR-1g(DD), CR-2g(DD), CR-7g(BB), CR-7g(EE)/		
	CR-1g(N), CR-2g(N), CR-4g(N), CR-5g(V)/		
	CR-1g(CC), CR-6g(AA), CR-7g(DD)/		
	CR-1g(EE), CR-7g(FF)/ CR-3g(L), CR-7g(N)/		
	CR-3a(Q), CR-4a(D)		

Cont'd on next page

SORTING SLOT CONTENTS LIST

Slot	Basic Skill Groups
252	CR-5a(B), CR-2g(BB), CR-3g(QQ), CR-3g(RR), CR-6g(N)
	253-254 None
255	/CR-1g(LL), CR-1g(MM), CR-5g(DD)/
	CR-2g(NN), CR-4g(LL)/ CR-1a(I)
256	/CR-8a(Q), CR-2g(M), CR-4g(M), CR-6g(M)/
	CR-7a(F), CR-6g(HH)/ CR-3g(VV), CR-7g(M)/
	CR-1g(M), CR-6a(O)
257	/CR-3a(I), CR-3a(N), CR-3g(K)/
	CR-3a(P), CR-3g(JJ), CR-6g(W)/
	CR-4a(M), CR-4a(N)/ CR-1g(Z), CR-7g(Z)/
	CR-2g(Y), CR-4g(X)/ CR-4a(F), CR-4a(L), CR-5a(Q),
	CR-8a(F), CR-8a(J), CR-9a(H), CR-1g(AA), CR-3g(X),
	CR-3g(OO), CR-4g(Y), CR-4g(BB), CR-5g(K), CR-6g(X),
	CR-6g(BB), CR-7g(AA)
258	None
259	CR-5a(P)
260	/CR-1g(S), CR-3g(F), CR-4g(S), CR-6g(R)/
	CR-5a(E), CR-6a(I), CR-7g(S)/
	CR-5a(J), CR-9a(G), CR-2g(F)/
	CR-1g(F), CR-7g(F)/
	CR-8a(E), CR-8a(O), CR-9a(Q), CR-4g(F)

SORTING SLOT CONTENTS LIST

	Slots 261 thru 280
Slot	Basic Skill Groups
	261-266 None
267	CR-5a(H)
268	None
269	CR-3g(O), CR-4g(D), CR-7g(R)
270	/CR-4g(Q), CR-6g(P)/ CR-1a(Q), CR-1a(Y), CR-1g(KK),
	CR-2g(D), CR-2g(P), CR-3g(D), CR-5g(M), CR-7g(D),
	CR-7g(Q)
271	CR-3g(TT), CR-7g(GG)
272	/CR-1g(L), CR-6g(L)/ CR-2g(L), CR-5g(U)/
	CR-4g(AA), CR-6g(Z)/ CR-1a(H), CR-5a(R), CR-1g(T),
	CR-2g(FF), CR-7g(T)
273	None
274	CR-7g(MM)
275	/CR-1g(I), CR-2g(I), CR-3g(XX), CR-3g(YY),
	CR-4g(I), CR-4g(JJ), CR-4g(KK), CR-6g(I)/
	CR-1g(J), CR-2g(J), CR-4g(E), CR-4g(J),
	CR-6g(J), CR-7g(J)/ CR-1a(AA), CR-1a(CC), CR-3g(J),
	CR-5g(P), CR-7g(LL)/ CR-2g(MM), CR-6g(KK), CR-7g(I)/
	CR-3g(I), CR-5g(Q)/ CR-4a(B), CR-7a(B), CR-9a(D),
	CR-9a(J), CR-9a(N), CR-3g(P), CR-2g(LL), CR-1g(D),
	CR-6g(D), CR-6g(JJ) Cont'd on next page

SORTING SLOT CONTENTS LIST

Slot	Basic Skill Groups
276	/CR-7a(K), CR-8a(S), CR-9a(L)/
	/CR-3g(BB), CR-3g(KK), CR-5g(1 /
	/CR-4g(HH), CR-5g(J)/ CR-2g(II), CR-5g(D)/ CR-5a(M)
277	/CR-1a(D), CR-3a(L), CR-3a(M), CR-7a(Q), CR-3g(MM)/
	CR-1a(Z), CR-3a(K), CR-3g(II)/
	CR-2g(JJ), CR-3g(UU), CR-4g(GG)/ CR-2a(F), CR-2a(G)/
	CR-3a(G), CR-8a(N)/ CR-1a(DD), CR-2a(V), CR-4a(C),
	CR-4a(R), CR-5a(I), CR-6a(C), CR-7a(I), CR-7a(J),
	CR-7a(R), CR-8a(D), CR-9a(F), CR-9a(K), CR-9a(S),
	CR-9a(T), CR-9a(U), CR-9a(V), CR-9a(W), CR-9a(X),
	CR-9a(Z), CR-1g(GG), CR-2g(GG), CR-3g(AA), CR-6g(GG),
	CR-7g(HH)
278	None
279	/CR-7a(E), CR-2a(I), CR-2a(K), CR-1g(X), CR-7g(X),
	CR-7g(Y)/ CR-9a(O), CR-1g(R), CR-2g(Q)/ CR-7a(L)
280	/CR-2a(U), CR-3a(J), CR-5a(C), CR-5a(G), CR-5a(L),
	CR-5a(N), CR-7a(H), CR-2g(S), CR-4g(R), CR-5g(O),
	CR-4g(V), CR-6g(Q), CR-6g(U)/ CR-2a(M), CR-4a(G),
	CR-5a(D), CR-5a(H), CR-8a(H), CR-2g(R), CR-4g(W)/
	CR-5a(O), CR-6a(N), CR-7a(M), CR-9a(AA),
	CR-3g(HH), CR-5g(CC)/ CR-4a(H), CR-6a(H),
	CR-6a(M), CR-8a(I)/ CR-1a(R), CR-2g(V), CR-3g(U)/

SORTING SLOT CONTENTS LIST

Slot	Basic Skill Groups
280	/CR-2a(J), CR-2a(L), CR-2a(W)/ CR-1a(V), CR-4a(P)/
	CR-3a(F), CR-3g(W)/ CR-6a(G), CR-3g(LL)/
	CR-6a(L), CR-8a(M)/ CR-1g(Y), CR-6g(E)/
	CR-2g(E), CR-7g(E)/ CR-2g(W), CR-6g(V)/
	CR-3g(E), CR-5g(N)/ CR-3g(GG), CR-5g(BB)/
	CR-2a(H), CR-2a(W), CR-3a(B), CR-3a(C), CR-7a(C),
	CR-7a(N), CR-9a(E), CR-9a(Y), CR-1g(E), CR-5g(Z)

	Slots 281 thru 300
Slot	Basic Skill Groups
	281-286 None
287	/CR-1g(A), CR-2g(B), CR-4g(A), CR-6g(B),
	CR-7g(A), CR-7g(B)/ CR-9a(A), CR-1g(O), CR-7g(O)/
	CR-2g(A), CR-6g(A)/
	CR-8a(A), CR-3g(M), CR-4g(O), CR-5g(S)
	288-291 None
292	/CR-2g(G), CR-6g(G)/ CR-4g(DD), CR-4g(EE)/ CR-2a(A),
	CR-2a(C), CR-3a(O), CR-6a(A), CR-3g(SS), CR-4g(G),
	CR-4g(CC), CR-6g(DD), CR-6g(EE)
	293-296 None
297	/CR-3a(A), CR-6a(F)/ CR-4a(E), CR-6a(K)/
	Cont'd on next page

SORTING SLOT CONTENTS LIST

Slot	Basic Skill Groups
297	/CR-3a(D), CR-6a(J)/ CR-2a(P), CR-2a(R), CR-2a(S),
	CR-2a(T), CR-4a(J), CR-9a(R), CR-6g(CC)
	298-300 None

Slots 301 thru 320	
Slot	Basic Skill Groups
	301-316 None
317	CR-1a(FF), CR-7a(U), CR-7g(V)
	318-320 None

Slots 321 thru 340	
Slot	Basic Skill Groups
	321-326 None
327	/CR-1g(P), CR-2g(C), CR-4g(C), CR-6g(C), CR-6g(O)/
	CR-8a(B), CR-2g(O), CR-3g(N)/ CR-5g(A), CR-7a(A)/
	CR-5g(L), CR-7g(P)/ CR-5g(G)
	328-331 None
332	/CR-1a(B), CR-1g(BB), CR-5g(W), CR-6g(Y)/
	CR-2g(Z), CR-3g(PP), CR-7g(C)/ CR-1g(H), CR-7g(H)/
	CR-2g(KK), CR-3g(H)/ CR-4g(P), CR-7g(CC)/
	CR-1a(P), CR-2a(B), CR-1g(C), CR-1g(JJ), CR-2g(EE), CR-3g(C), CR-3g(WW)
	Cont'd on next page

SORTING SLOT CONTENTS LIST

Slot	Basic Skill Groups	Slot	Basic Skill Groups
	333-336 None	337	CR-2g(H), CR-4g(H),
337	/CR-5a(F), CR-7a(G),		CR-6g(H)/
	CR-9a(M), CR-4g(U)/		CR-8a(K), CR-2g(U)/
	CR-4a(O), CR-3g(FF),		CR-1a(X), CR-2a(Q),
	CR-3g(Z), CR-4g(II)/		CR-3a(E), CR-6a(B),
	CR-5a(K), CR-1g(W),		CR-4g(Z)
	CR-3g(S), CR-6g(T)/		338-340 None

	Slots 341 thru 360		
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	341-356 None		358-360 None
357	/CR-9a(P), CR-7g(W)/		

	Slots 361 thru 380		
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	361-371 None	372	CR-2g(T), CR-3g(R)
372	/CR-1g(G), CR-7g(G)/		373-380 None

	Slots 381 thru 400		
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	381-391 None		393-396 None
392	CR-1a(F), CR-7a(P)		Cont'd on next page

SORTING SLOT CONTENTS LIST

Slot	Basic Skill Groups	Slot	Basic Skill Groups
397	CR-1g(U)		398-400 None

	Slots 401 thru 420		
Slot	Basic Skill Groups		
	None		

	Slots 421 thru 440		
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	421-434 None	440	CR-1a(G), CR-2a(E),
435	CR-8a(C)		CR-4a(K)
	436-439 None		

	Slots 441 thru 460		
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	441-456 None	457	CR-8a(G)
457	CR-6a(D), CR-6a(E),		458-460 None

	Slots 461 thru 480		
Slot	Basic Skill Groups	Slot	Basic Skill Groups
	461-476 None		478-480 None
477	CR-7a(S)		

TASK LIST

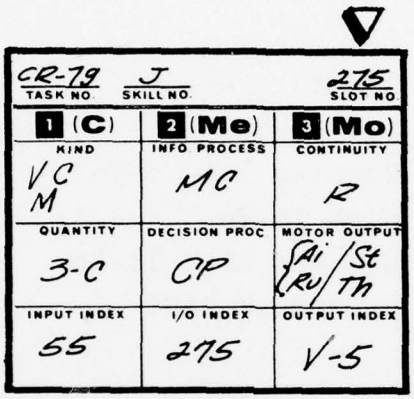
Air/Air Tasks

CR-1a Single Turn Conversion
CR-2a Reattack
CR-3a Reversal
CR-4a Counter Reversal
CR-5a Low Yo-Yo
CR-6a Counter Low Yo-Yo
CR-7a High Yo-Yo
CR-8a Counter High Yo-Yo
CR-9a Racetrack DART

Air/Ground Tasks

CR-1g High Dive Bomb
CR-2g High Dive Toss
CR-3g Low Angle Pop-Up
CR-4g Low Angle Strafe
CR-5g Nuclear LADD
CR-6g Low Angle Dive Bomb
CR-7g 30° Dive Rockets

It was necessary to cross reference each task sequence within the surface task analysis with the classification matrix and all the other components of the taxonomy. It should be noted that the data contained on the skill card for each task sequence can also be found in a block above the motor action entry of the sequence.



CR-7g TASK NO.	J SKILL NO.		275 SLOT NO.
1 (C)	2 (Me)	3 (Mo)	
KIND: VC M	INFO PROCESS: MC	CONTINUITY: R	
QUANTITY: 3-C	DECISION PROC: CP	MOTOR OUTPUT: (Ai/Ru) St/Th	
INPUT INDEX: 55	I/O INDEX: 275	OUTPUT INDEX: V-5	

Figure B-3.
Typical skill card which can be found in the card file.

TASK NO. CR-7g TASK 30° Rockets Delivery/Controlled Range AIRCRAFT F-4E

TASK GOAL Perform Rocket Delivery DATE Sept., 1977

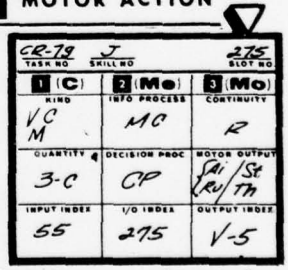
EL. SEQ.	1 CUES	2 MENTAL ACTION	3 MOTOR ACTION
J.	CONTINUES ROLL OUT Visual-Pitch att: decreasing Bank att: roll Target Range landmarks Leading aircraft Aural-Normal aircraft sound Control-Increased aileron & rudder, decreased stabilator pressure Motion-Decreasing positive G, pitching down, rolling	Determines satisfactory roll rate & need to reduce power	 Maintains coordinated aileron & rudder with stabilator movement, adjusts throttle

Figure B-4.
Surface analysis example
with skill data and sorting slot numbers.

APPENDIX C

TASK PROFILES OF REPRESENTATIVE TASKS

CR-1a Single Turn Conversion Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
V 0	1-C 0	freq. 20 1 25 4 30 2 35 6 40 4 45 9 50 4 55 2 aver. 40	MC 17	CP 18	freq. 35 2 40 1 50 2 60 2 70 4 80 2 90 2 100 4 110 1 125 2 200 1 225 7 250 1 275 1 aver. 125	Ai | St - 11	V-1 3
			MC(I) 1	SP 14		{Ai, Ru | St - 11	
VA 0 VC 2 VM 0	2-C 2		MR(I) 3			Ai, Ru, St - 5	V-2 16
			SC 4	CONT.		St - 2	V-3 0
VAC 5 VAM 0 VCM 6	3-C 11		SC(I) 3	A 14		{Ai, Ru | St, Th - 1	
			I 4	R 18		Th - 1	V-4 0
VACM 19	4-C 19					{Ai, Ru | Th - 1	V-5 13

CR-2a Reattack Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
V 0	1-C 0	freq. 35 3 40 1 45 1 50 6 55 9 60 2 70 1	MC 13	CP 21	freq. 70 3 90 1 100 1 110 3 120 2 140 1 200 1 220 2 250 5 275 4	Ai - 11 Ru St	V-1 0
VA 0 VC 0 VM 0	2-C 0		MC(I) 6	SP 2		{Ai, Ru | St - 8	V-2 11
			MR(I) 2			{Ai, St, Ru - 2	
VAC 4 VAM 0 VCM 0	3-C 4		SC 2	CONT.		{Ai, Ru | St, Th - 1	V-3 0
			SC(I) 0	A 8		{Ai, Ru | St, Th, Tr - 1	V-4 2
VACM 19	4-C 19	aver. 51	I 0	R 15	aver. 178		V-5 10

CR-3a Reversal Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
		freq.	MC	CP	freq.		V-1
V	1-C	30 1 35 3 45 2 50 5 55 3 60 3 65 1	13	16	60 1 70 1 90 1 100 4 110 3 120 3 130 1 175 2 225 1 250 1	Ai - 11 Ru St	0
0	0		MC(I)				V-2
VA 0 VC 0 VM 0	2-C 0		3	SP 2		{Ai, Ru} St - 2	14
			MR(I)			{Ai, Ru} St - 2 Th	V-3
VAC 0 VAM 0 VCM 2	3-C 2		1	CONT.			0
			SC	A			V-4
			1	9			0
			SC(I)				
VACM	4-C		0	R			V-5
16	16		I	9			4
		aver. 49	0		aver. 126		

CR-4a Counter Reversal Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
		freq.	MC	CP	freq.		V-1
V	1-C	30 2	12		60 1	Ai - 4	
0	0	40 4		15	80 3	St	0
		45 3	MC(I)		90 3		
		50 4			100 3	Ai / Ru | St - 5	V-2
		55 4	2	SP	110 2		
		60 1			120 1	St - 3	13
VA 0	2-C		MR(I)	3	150 1		
VC 0					200 1	Ai / Ru | St - 2	
VM 0	0		1		250 1	Th	
				CONT	275 2	St - 2	V-3
			SC			Ru	0
VAC 0	3-C			A		Ai - 1	
VAM 0			1			Ru	
VCM 3	3					St	V-4
			SC(I)	9		Th - 1	
			0			St	0
VACM	4-C			R			V-5
			I				
15	15		2	9			5
		aver. 46			aver. 131		

CR-5a Low Yo-Yo Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
		freq.	MC	CP	freq.		
V	1-C	30 2	15	18	60 3	{Ai | Ru | St - 9	V-1
0	0	45 1			90 1		1
		50 5	MC(I)		100 1	Ai | St - 3	
		55 5	0	SP	110 1		V-2
		60 4			120 2		
VA 0	2-C	65 1	MR(I)	0	250 4	Ai | Ru | St - 3	7
VC 1			3		275 4		
VM 0	1			CONT.	300 1	St - 2	V-3
			SC		325 1	Th | St - 1	
VAC 1	3-C		0	A			0
VAM 0							V-4
VCM 1	2		SC(I)	8			
			0				1
VACM	4-C		I	R			V-5
15	15		0	10			9
		aver. 52			aver. 191		

CR-6a Counter Low Yo-Yo Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
		freq.	MC	CP	freq.		
V	1-C	35 3	9	15	50 1	Ai - 8	V-1
0	0	40 1			55 1	St	
		45 4			70 2		2
		50 2	MC(I)		80 1	Ai Ru | St - 6	
		55 6			90 3		
		60 1	4	SP	100 1	St - 2	V-2
VA 0	2-C				110 2		
VC 0			MR(I)	2	175 1	Ai - 1	9
VM 0	0		1		225 2	Ru	
				CONT	275 2	St	
			SC		300 1		V-3
VAC 0	3-C		0	A			0
VAM 0							V-4
VCM 1	1		SC(I)	11			0
			2				
VACM	4-C		I	R			V-5
16	16		1	6			6
		aver. 48			aver. 141		

CR-7a High Yo-Yo Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
V 0	1-C 0	freq. 30 1 35 1 40 1 45 3 50 2 55 6 60 3 65 1 75 1 aver. 52	MC 14 MC(I) 0 MR(I) 2 SC 1 SC(I) 1 I 1	CP 17 SP 2 CONT. A 4 R 15	freq. 40 1 55 1 60 1 90 3 110 3 120 2 175 1 200 1 220 1 250 1 275 1 300 1 325 1 375 1 aver. 164	{Ai, Ru | St - 5 Ai, Ru, St - 4 Ai, St - 4 {Ai, St, Ru - 2 St - 2 {Ai, St, Ru | Th - 1 Tr, St - 1	V-1 2 V-2 9 V-3 0 V-4 2 V-5 6
VA 0 VC 1 VM 0	2-C 1						
VAC 1 VAM 0 VCM 1	3-C 2						
VACM 16	4-C 16						

CR-8a Counter High Yo-Yo Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
		freq.	MC	CP	freq.		V-1
V	1-C	20 1 25 1 30 1 45 3 50 3 55 7 65 3	11	16	40 1 50 1 55 2 90 2 100 2 110 3 130 2 150 1 225 1 250 1 275 2 325 1	Ai - 6 St	2
0	0		MC(I)			{Ai, Ru | St - 5	V-2
VA 0 VC 2 VM 0	2-C 2		1	SP 3		Ai - 3 Ru St	11
			MR(I)			St - 3	V-3
VAC 1 VAM 0 VCM 0	3-C 1		2	CONT.		{Ai, St, Ru | Th - 1	0
			SC	A		Tr - 1 St	V-4
			1	12			0
VACM	4-C		SC(I)				V-5
16	16		3	R			6
		aver. 49	I	7	aver. 141		
			1				

CR-9a Racetrack DART Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
		freq.	MC	CP	freq.		
V	1-C	30 1 35 1 40 4 45 3 50 1 55 4 60 3 65 4 70 5 75 1	20	24	55 1 60 1 80 3 90 1 100 1 110 3 120 2 130 2 140 2 150 2 175 1 200 1 225 2 280 1 300 1 325 2 350 1	Ai - 6 | Th - 1 St | Tr | St Ai - 5 | Tr - 1 Ru | St St | Ai - 3 | Ai - 1 St | Ru Ru | St | Tr Th - 3 Ai | Ai -1 St | Ru Tr Ru | St Ai | St - 3 Ru | Ai | St - 1 Ru | Th Ai | St - 1 Ru | Tr St - 1	V-1 1
0	0		MC(I)				V-2
			3	SP			
VA 0 VC 2 VM 0	2-C 2		MR(I)	3			17
			4				V-3
			SC	CONT.			
VAC 5 VAM 0 VCM 0	3-C 5		0	A			0
			SC(I)	9			V-4
			0				1
VACM	4-C		I	R			V-5
20	20		0	18			8
		aver. 55			aver. 161		

CR-1g High Dive Bomb Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
		freq.			freq.		
V 0	1-C 0	30 1 35 5 40 4 45 9 50 8 55 6 60 3 65 1 70 2 75 1	MC 28	CP 34	45 2 55 1 60 1 70 4 80 2 90 7 100 4 110 3 120 1 130 1 140 1 175 1 200 2 220 1 250 4 275 1 280 1 300 2 375 1	Ai, St - 11; St - 3 Th, St - 4 Tr, St - 3	V-1 3
VA 0 VC 6 VM 0	2-C 6		MC(I) 4	SP 6		Ai, Ru, St - 3; Th Ai, Ru, St - 5	V-2 24
VAC 7 VAM 0 VCM 10	3-C 17		MR(I) 6	CONT.		Ai, St, Ru - 4 Ai, Ru, St - 6 Ai, St, Ru, Th - 1	V-3 0
			SC 0	A 24			V-4 2
VACM 17	4-C 17		SC(I) 0	R 16			V-5 11
		aver. 49	I 2		aver. 143		

CR-2g High Dive Toss Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
		freq.	MC	CP	freq.		V-1
V	1-C	25 1	29	35	40 1	Ai - 12 | Tr - 1 St | St	2
0	0	30 1 35 4 40 8	MC(I)		50 1 55 1 70 3	Th - 1 | Ai - 1 St | Ru St Tr	V-2
VA 0 VC 6 VM 0	2-C 6	45 7 50 5 55 9 60 2 65 3 70 1	3 MR(I) 7	SP 6	80 7 90 6 100 1 110 4 120 2 130 1 150 1 175 1	{Ai | St Ru | St} - 8 {Ai | St Ru | Th} - 4	25 V-3
VAC 7 VAM 1 VCM 9	3-C 17		SC 0	CONT.	225 1 250 4 275 4 280 1 325 2	Ai Ru - 5 St	0 V-4
			SC(I) 0	A 23		{Ai Ru - 1 St} {Ai | St - 1 Ru | Tr}	1
VACM 18	4-C 18		I 2	R 18		St - 5 Th - 1 Tr St	V-5 13
		aver. 48			aver. 145		

CR-3g Low Angle Pop-Up Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
V 0	1-C 0	freq. 25 4 30 2 35 8 40 11 45 8 50 14 55 3 60 3	MC 36	CP 41	freq. 35 1 40 1 45 1 50 4 70 5 60 2 80 9 90 3 100 8 110 2 120 1 125 1 175 2 200 1 225 4 250 5 275 1 300 2	{Ai, St} - 14 {Ai, Ru, St} Th- 1 {Ai, Ru} St-13 Ai, Ru, St - 1 Ai, Ru, St - 8 St, Tr St - 6 Th, Tr - 1, St Th, St - 2 Th, Ai, Ru, St - 1 {Ai, Ru} St, Th - 1 {Ai, Ru} St, Tr Tr, St - 2 {Ai, Ru} St, Tr - 1 {Ai, Ru, St} - 1 {Ai, St} - 1	V-1 5
VA 0 VC 6 VM 0	2-C 6		MC(I) 3	SP 12			V-2 31
VAC 6 VAM 0 VCM 11	3-C 17		MR(I) 8	CONT.			V-3 0
VACM 30	4-C 30	aver. 43	SC 1 SC(I) 3 I 2	A 32 R 21	aver. 125		V-4 1 V-5 16

CR-4g Low Angle Strafe Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
V 0	1-C 0	freq. 30 2 35 2 40 6 45 8 50 9 55 6 60 4 65 1 70 1	MC 26	CP 34	freq. 45 2 55 1 60 1 70 1 80 6 90 6 100 3 110 1 120 4 130 1 140 1 150 1 250 6 275 4 350 1	{Ai | St Ru | St - 7	V-1 3
			MC(I) 6			Ai | St - 8	
VA 0 VC 5 VM 0	2-C 5		MR(I) 6	SP 5		Ai | Ru | St - 9	V-2 23
			SC 0	CONT.		Th | St - 3	
VAC 7 VAM 0 VCM 10	3-C 17		SC(I) 0	A 24		{Ai | St Ru | Th - 4	V-3 0
						St - 3	
						Tr | St - 3	V-4 1
VACM 17	4-C 17		I 1	R 15		{Ai St Ru - 1	
		aver. 48			aver. 142	Ai | Ru - 1	V-5 12

CR-5g Nuclear LADD Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
V 0	1-C 0	freq. 15 1 20 1 25 1 30 2 35 5 40 7 45 5 50 4 55 4 60 1 aver. 41	MC 19	CP 21	freq. 30 1 35 1 40 2 45 1 50 2 60 2 70 4 80 3 90 2 100 2 110 2 200 3 225 2 250 1 275 2 300 1 aver. 119	Ai - 10 St	V-1 4
						St - 6	
VA 0 VC 7 VM 0	2-C 7		MC(I) 1	SP 10		Ai / Ru | St - 6	V-2 18
			MR(I) 4			Th - 2 St	
				CONT.		Tr - 3 St	V-3 0
VAC 7 VAM 0 VCM 5	3-C 12		SC 2	A 16		Ai / Ru | St - 1 Th	V-4 0
			SC(I) 5			Ai Ru St - 1	
VACM 12	4-C 12		I 0	R 15		Ai / Ru / St | Th - 1	V-5 9
						Ai / St - 1	

CR-6g Low Angle Dive Bomb Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
V 0	1-C 0	freq. 30 1 35 6 40 7 45 6 50 8 55 4 60 3 65 4	MC 26	CP 32	freq. 40 1 55 1 70 6 80 4 90 6 100 3 120 2 130 3 150 1 200 3 250 4 275 3 300 1 325 1	Ai | St - 9	V-1 2
			MC(I) 6			Ai | Ru | St - 9	V-2 24
VA 0 VC 5 VM 0	2-C 5		MR(I) 6	SP 7		{Ai | Ru} St - 8	
			SC 0	CONT.		{Ai | Ru} St | Th - 4	V-3 0
VAC 6 VAM 0 VCM 10	3-C 16		SC(I) 0	A 24		Tr | St - 3 St - 2 Th | St - 2	V-4 0
VACM 18	4-C 18		I 1	R 15		St | Ru - 1 {Ai | Ru} St | Tr - 1	V-5 13
		aver. 47			aver. 141		

CR-7g 30° Dive Rockets Task Profile

CUES KIND	QUANTITY	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	INPUT/OUTPUT INDEX	MOTOR OUTPUT (Effector Output)	OUTPUT INDEX
V 0	1-C 0	freq. 30 1 35 2 40 7 45 12 50 6 55 7 60 1 65 3 70 2	MC 28	CP 34	freq. 45 2 55 1 60 1 70 1 80 6 90 9 100 4 110 1 130 1 140 2 175 1 200 2 220 2 225 1 250 1 260 1 275 3 300 1 325 1	Ai - 11 | St | Th - 1 | Ai | St | Ru {Ai, Ru | St - 6 Ai - 7 | Ru | St {Ai, St, Ru - 5 Tr - 4 | St Th - 2 | St {Ai, Ru | St, Th - 3 St - 2	V-1 3
VA 0 VC 6 VM 0	2-C 6		MC(I) 6	SP 7			V-2 25
VAC 7 VAM 0 VCM 12	3-C 19		MR(I) 7	CONT.			V-3 0
VACM 16	4-C 16	aver. 49	SC 0	A 22	aver. 139		V-4 4
			SC(I) 0	R 19			V-5 9
			I 1				

APPENDIX D

TASK/SKILL DISTRIBUTION DATA

Task/Skill Distribution Within The Single Turn Conversion

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	A-212	
1a(P)*	B-332	1g(BB), 3g(WW), 5g(W), 6g(O), 6g(Y), 2g(Z)*, 3g(C)*, 4g(P)*, 7g(C)*
	C-195	
3a(L), 3a(M), 7a(Q) 1a(Z)*, 3a(K)*, 3a(G)*, 5a(I)*, 8a(N)*	D-277	3g(MM), 3g(II)*
1a(W)*, 1a(S)	E-20	
	F-392	
	G-440	
	H-272	1g(T)*
	I-255	1g(LL)*, 1g(MM)*, 2g(NN)*, 4g(LL)*, 5g(DD)*
	J-196	
	K-16	3g(CC)
	L-16	
	M-217	
	N-212	
	O-132	
1a(B)*	P-332	1g(BB)*, 3g(C)*, 5g(W)*, 6g(Y)*
	Q-270	
1a(V)*, 2a(U)*, 3a(J)*, 4a(P)*, 5a(C)*, 5a(G)*, 7a(H)*	R-280	2g(V), 3g(U), 2g(S)*, 4g(R)*, 4g(V)*, 6g(Q)*, 6g(U)*
1a(W)*, 1a(E)	S-20	
4a(A)	T-132	3g(G)*
7a(D)	U-200	3g(T)*
1a(R)*, 6a(G)*, 4a(P),	V-280	2g(V)*, 3g(U)*, 3g(LL)*
1a(E)*, 1a(S)*	W-20	
3a(E)*, 4a(O)*, 5a(F)*, 7a(G)*, 9a(M)*	X-337	3g(FF)*, 4g(U)*, 4g(II)*

Task/Skill Distribution Within
The Single Turn Conversion

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	Y-270	
1a(D)*, 3a(L)*, 3a(K), 3a(M)*, 5a(I)*, 7a(Q)*	Z-277	3g(II), 3g(MM)*
	AA-275	3g(J), 5g(P), 7g(LL)
	BB-157	
	CC-275	3g(J), 5g(P), 7g(LL)
	DD-277	
	EE-37	
	FF-317	

Task/Skill Distribution
Within the Reattack

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	A-292	6g(DD)*
	B-332	2g(EE)*
	C-292	
	D-195	
	E-440	
2a(G)	F-277	
2a(F)	G-277	
2a(J)*, 2a(L)*, 2a(N)*	H-280	
7a(L)*, 7a(E), 2a(K)	I-279	1g(X), 5g(O), 7g(X), 7g(Y)
2a(H)*, 2a(L), 2a(N)	J-280	
7a(L)*, 7a(E), 2a(I)	K-279	1g(X), 5g(O), 7g(X) 7g(Y)
2a(H)*, 2a(J), 2a(N)	L-280	
4a(G), 5a(D), 5a(H), 8a(H)	M-280	2g(R), 4g(W)
2a(H)*, 2a(J), 2a(L)	N-280	
	O-40	
2a(R)*, 2a(T)*	P-297	
	Q-337	
2a(T)*, 2a(P)*	R-297	
9a(R)*	S-297	
2a(P)*, 2a(R)*	T-297	
3a(J), 5a(C), 5a(G), 5a(L), 5a(N), 7a(H)	U-280	2g(S), 4g(R), 4g(V), 6g(Q), 6g(U)
	V-277	
	W-280	

Task/Skill Distribution
Within the Reversal

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
6a(F)	A-297	
8a(M)*, 6a(L)*	B-280	
	C-280	
6a(J)	D-297	
1a(X)*, 4a(O)*	E-337	3g(FF)*, 4g(II)*
	F-280	3g(W)
1a(D)*, 3a(L)*, 8a(N), 5a(I)*, 9a(F)*, 9a(X)*	G-277	3g(MM)
	H-37	
3a(P)*, 3a(N)	I-257	3g(K), 3g(JJ)*, 6g(BB)*, 6g(W)*
2a(U), 5a(C), 5a(G), 5a(L), 5a(N), 7a(H)	J-280	2g(S), 4g(R), 4g(V), 6g(Q), 6g(U)
3a(L)*, 3a(M)*, 1a(Z), 1a(D)*, 5a(I)*	K-277	3g(II), 3g(MM)*
1a(D), 7a(Q)	L-277	3g(MM)
1a(D), 7a(Q)	M-277	3g(MM)
3a(P)*, 3a(I)	N-257	3g(K), 3g(JJ)*, 6g(W)*, 6g(BB)*
	O-292	
3a(I)*, 3a(N)*	P-257	3g(PP), 6g(W), 6g(BB), 3g(K)*
	Q-252	
	R-177	

Task/Skill Distribution Within
The Counter Reversal

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
1a(T)*	A-132	3g(G)*
	B-275	5g(Q)*, 3g(I)*
9a(S)*	C-277	
	D-252	
6a(K)	E-297	
	F-257	
2a(M), 5a(D), 5a(H), 8a(H)	G-280	2g(R), 4g(W), 5g(O)
6a(L)*, 8a(M)*, 6a(H), 6a(M), 8a(I)	H-280	
	I-157	
	J-297	
	K-437	
4a(M)*, 4a(N)*	L-257	
4a(L)*, 4a(N)	M-257	
4a(L)*, 4a(M)	N-257	
5a(F)*, 7a(G)*, 9a(M)*, 1a(X)*, 3a(E)*, 5a(K)*	O-337	3g(FF), 4g(II), 1g(W)*, 3g(S)*, 4g(U)*, 6g(T)*
6a(G)*, 1a(R)*, 1a(V)	P-280	3g(LL)*, 2g(V)*, 3g(V)*
	Q-37	
	R-277	

Task/Skill Distribution
Within the Low Yo-Yo

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
8a(B)*, 7a(A)	A-327	1g(P)*, 2g(C)*, 2g(O)*, 3g(N), 6g(C)*
	B-252	2g(BB)*, 3g(RR)*
2a(U), 3a(J), 5a(G), 5a(L), 5a(N), 7a(H)	C-280	2g(S), 4g(R), 4g(V), 6g(Q), 6g(U)
2a(M), 4a(G), 5a(H), 8a(H)	D-280	2g(R), 4g(W)
6a(I)	E-260	7g(S), 1g(F)*, 1g(S)*, 4g(S)*, 7g(F)*
7a(G), 9a(M)	F-337	4g(U)
2a(U), 3a(J), 5a(C), 5a(L), 5a(N), 7a(H)	G-280	2g(S), 4g(R), 4g(V), 6g(Q), 6g(U)
2a(M), 4a(G), 5a(D), 8a(H)	H-280	2g(R), 4g(W)
1a(D)*, 1a(Z)*, 3a(L)*, 3a(K)*	I-277	3g(II)*, 3g(MM)*
9a(G)	J-260	2g(F)
5a(E)*, 9a(G)*, 9a(M)*	K-337	1g(W), 3g(S), 6g(T), 4g(U)*
2a(U), 3a(J), 5a(C), 5a(N), 5a(G), 7a(H)	L-280	2g(S), 4g(R), 4g(V), 6g(Q), 6g(U)
7a(K)*, 8a(S)*, 9a(K)*	M-276	3g(BB)*, 3g(KK)*, 5g(I)*
2a(U), 3a(J), 5a(C), 5a(L), 5a(G), 7a(H)	N-280	2g(S), 4g(R), 4g(V), 6g(Q), 6g(U)
6a(N), 7a(M), 9a(AA)	O-280	3g(HH), 5g(CC)
	P-259	
	Q-257	
	R-272	

Task/Skill Distribution Within
The Counter Low Yo-Yo

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	A-292	
	B-337	
	C-277	
	D-457	
8a(G)*, 6a(E)*	E-457	
3a(A)	F-297	
1a(V)*, 4a(F)*, 1a(R)*	G-280	3g(LL), 3g(U)*, 2g(V)*
4a(H), 6a(M), 8a(I)	H-280	
5a(E)	I-260	7g(S)
3a(D)	J-297	
4a(E)	K-297	
8a(M)	L-280	
4a(H), 6a(H), 8a(I)	M-280	
5a(O), 7a(M), 9a(AA)	N-280	3g(HH), 5g(CC)
8a(Q)	O-256	4g(M)*, 6g(M)*, 2g(M)*
	P-16	4g(M)
8a(R)	Q-137	

Task/Skill Distribution Within the High Yo-Yo

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
8a(B)*, 5a(A)	A-327	2g(O)*, 3g(N)*, 4g(C)*, 1g(P)*, 2g(C)*, 6g(C)*
	B-275	
7a(N)*, 9a(Y)*	C-280	
1a(U)	D-200	3g(T)*
7a(L)*, 2a(I), 2a(K)	E-279	5g(O), 7g(X), 7g(Y)
6a(O)*	F-256	6g(HH), 3g(VV)*, 7g(M)* 1g(M)*
4a(O)*, 5a(K)*, 5a(F), 9a(M)	G-337	4g(U), 3g(FF)*, 4g(II)* 1g(W)*, 3g(S)*
2a(U), 3a(I), 5a(C), 5a(G), 5a(L), 5a(N)	H-280	2g(S), 4g(R), 4g(V), 6g(Q), 6g(U)
7a(J)*, 1a(DD)*	I-277	
7a(I)*, 1a(DD)*	J-277	
5a(M)*, 9a(S), 9a(L)	K-276	3g(BB)*, 3g(KK)*, 5g(I)*, 4g(HH)*, 5g(I)*
7a(E)*, 2a(I)*, 2a(K)*	L-279	1g(X)*, 7g(X)*, 7g(Y)*
5a(O), 6a(N), 9a(AA)	M-280	3g(HH), 5g(CC)
7a(C)*, 9a(Y)*, 5a(O)*, 6a(N)*, 7a(M)*, 9a(AA)*	N-280	3g(HH)*, 5g(CC)*
	O-17	2g(OO), 6g(MM), 1g(NN)*, 5g(F)*
	P-392	
5a(I)*, 1a(D), 3a(L), 3a(M)	Q-277	3g(MM)
	R-277	
	S-477	

Task/Skill Distribution Within
The Counter High Yo-Yo

AIR/AIR SKILLS *kindred skills	Skill Slot	AIR/GROUND SKILLS *kindred skills
	A-287	
	B-327	2g(O), 3g(N), 5g(G)*, 2g(C)*, 1g(P)*, 4g(C)*, 6g(C)*
	C-435	
	D-277	
	E-260	
	F-257	
6a(E)*	G-457	
2a(M), 4a(G), 5a(D), 5a(H)	H-280	2g(R), 4g(W)
4a(H), 6a(H), 6a(M)	I-280	
	J-257	
5a(K)*	K-337	2g(U), 2g(H)*, 1g(W)*, 3g(S)*, 4g(H)*, 6g(H)*, 6g(T)*
8a(P)*	L-217	
3a(B)*, 6a(L)	M-280	
1a(D)*, 3a(B)*, 3a(G)*, 3a(L)*, 5a(I)*, 7a(Q)*, 9a(F)*, 9a(X)*	N-277	3g(MM)*
	O-260	
8a(L)*	P-217	
6a(O)*	Q-256	2g(M), 6g(M), 3g(VV)*, 7g(M)*, 1g(M)*
	R-137	
5a(M)*, 7a(K), 9a(L)	S-276	3g(BB)*, 3g(KK)*, 5g(I)*, 4g(HH)*, 5g(J)*

Task/Skill Distribution Within
The Racetrack DART

AIR/AIR SKILLS *kindred skills	Skill Slot	AIR/GROUND SKILLS *kindred skills
8a(A)*	A-287	1g(O), 7g(O), 2g(A)*, 3g(M)*, 6g(A)*, 6g(O)*
	B-87	
	C-52	
	D-275	
	E-280	
5a(I)*, 9a(X)*, 3a(G)*, 8a(N)*	F-277	
5a(E)*, 6a(I)*, 5a(J)	G-260	2g(F), 4g(F)*, 1g(F)*, 7g(F)*, 7g(S)*
	H-257	
	I-92	5g(B)*
9a(N)*	J-275	1g(D)*
	K-277	
5a(M)*, 7a(K), 8a(S)	L-276	3g(BB)*, 3g(KK)*, 5g(I)*, 4g(HH)*, 5g(J)*
4a(O)*, 5a(K)*, 5a(F), 7a(G)	M-337	4g(U), 1g(W)*, 3g(S)*, 3g(FF)*, 4g(II)*, 6g(T)*
9a(J)*	N-275	1g(D)*
	O-279	1g(R), 2g(Q)
	P-357	7g(W)*
	Q-260	
2a(S)*	R-297	6g(CC)*
9a(U)*, 4a(C)*	S-277	
	T-277	
9a(S)*	U-277	
	V-277	
	W-277	
9a(F)*, 3a(G)*, 8a(N)*	X-277	
7a(C)*, 7a(N)*, 5a(O)*, 6a(N)*, 7a(M)*, 9a(AA)*	Y-280	5g(CC)*
	Z-277	
5a(O), 6a(N), 7a(M)	AA-280	3g(HH), 5g(CC)

Task/Skill Distribution Within The High Dive Bomb

AIR/AIR SKILLS *kindred skills	Skill Slot	AIR/GROUND SKILLS *kindred skills
	A-287	2g(B), 4g(A), 6g(B), 7g(A)
	B-247	4g(B)
	C-332	7g(C)*
9a(J)*, 9a(N)*	D-275	
	E-280	2g(E)*, 6g(E)*, 7g(E)*
5a(E)*, 6a(I)*	F-260	7g(F), 2g(F)*, 4g(F)*, 6g(F)*, 7g(S)*
	G-372	7g(G), 3g(R)*
	H-332	7g(H)
	I-275	2g(I), 3g(XX), 3g(YY), 4g(I), 4g(JJ), 4g(KK), 6g(I), 7g(I)*
	J-275	2g(J), 4g(E), 4g(J), 6g(J), 7g(J)
	K-17	2g(K), 4g(K), 6g(K), 7g(K)
	L-272	2g(L)*, 6g(L)*
	M-256	2g(M), 4g(M), 6g(M), 7g(M)*
	N-252	2g(N), 4g(N), 7g(N)*
9a(A)	O-287	7g(O), 2g(O)*
	P-327	2g(C), 6g(C), 2g(N), 6g(N)*, 7g(N)*
	Q-30	
9a(O)	R-279	2g(Q)
	S-260	3g(F), 4g(S), 6g(R), 7g(S)*, 7g(E)*, 1g(F)*
	T-272	2g(FF)*, 2g(L)*, 5g(V)*, 6g(Z)*, 7g(T)*
	U-397	
	V-77	

Task/Skill Distribution Within
The High Dive Bomb

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
5a(F)*, 8a(K)*, 9a(M)*, 5a(K)	W-337	3g(S), 6g(T), 2g(U)*, 4g(U)*
7a(L)*, 2a(E), 2a(I), 2a(K)	X-279	7g(X), 7g(Y)
	Y-280	6g(E)
3a(P)*	Z-257	7g(Z), 3g(JJ)*, 6g(W)*, 6g(BB)*
	AA-257	4g(Y)*
1a(B)	BB-332	5g(W), 6g(O), 6g(Y), 2g(Z)*, 2g(KK)*, 3g(PP)*
	CC-252	6g(AA), 7g(DD)
	DD-252	2g(DD), 7g(BB), 7g(EE)
	EE-252	7g(FF)
	FF-31	4g(FF)
	GG-277	6g(GG)*,
	HH-36	7g(II)*
7a(O)*	II-17	7g(JJ), 2g(OO)*, 5g(F)*, 6g(MM)*
	JJ-332	4g(P), 7g(CC), 2g(KK)*, 3g(PP)*
	KK-270	2g(P)
1a(I)*	LL-255	1g(MM), 5g(DD), 2g(NN)*, 4g(LL)*
1a(I)*	MM-255	1g(LL), 5g(DD), 2g(NN)* 4g(LL)*
7a(O)*	NN-17	2g(OO)*, 6g(MM)*

Task/Skill Distribution Within
The High Dive Toss

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	A-287	6g(A), 1g(A)*, 2g(A)*
	B-287	1g(A), 4g(A), 6g(B), 7g(A)
	C-327	1g(P), 2g(C), 6g(C)
	D-270	
	E-280	7g(E), 1g(E)*, 6g(E)*
5a(J), 9a(G)	F-260	1g(F)*, 4g(F)*, 6g(F)*, 7g(F)*
	G-392	4g(G), 6g(G)
	H-337	4g(H), 6g(H)
	I-275	1g(I), 3g(XX), 3g(YY), 4g(I), 4g(JJ), 4g(KK), 6g(I), 7g(I)*
	J-275	1g(J), 4g(E), 4g(J), 6g(J), 7g(J)
	K-17	1g(K), 4g(K), 6g(K), 7g(K)
	L-272	6g(L)*
8a(Q)	M-256	1g(M), 4g(M), 6g(M), 7g(M)*
	N-252	1g(N), 4g(N), 7g(N)*
8a(B)	O-327	3g(N), 1g(O)*, 7g(O)*
	P-270	
9a(O)	Q-279	1g(R)
2a(M), 4a(G), 5a(D), 5a(H), 8a(H)	R-280	4g(W), 5g(O)
2a(U), 3a(J), 5a(C), 5a(G), 5a(L), 5a(N), 7a(H)	S-280	4g(R), 4g(V), 6g(Q), 6g(U)
	T-372	
5a(K)*, 5a(F)*, 8a(K), 7a(G)*, 9a(M)*	U-337	2g(H)*, 4g(H)*, 6g(H)*, 1g(W)*, 3g(S)*, 6g(T)*, 4g(U)*
1a(R)	V-280	3g(U), 6g(U)*

Task/Skill Distribution Within
The High Dive Toss

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	W-280	6g(V), 3g(E)*, 5g(N)*
	X-17	
9a(H)*	Y-257	4g(X), 3g(OO)*
1a(B)*	Z-332	3g(PP), 7g(C), 1g(BB)*, 3g(C)*, 4g(F)*, 5g(W)*, 6g(Y)*, 7g(CC)*
	AA-132	
	BB-252	
	CC-12	
	DD-252	1g(DD), 7g(BB), 7g(EE), 1g(CC)*, 3g(QQ)*, 6g(AA)*, 7g(DD)*
2a(B)*	EE-332	
	FF-272	
	GG-277	
	HH-37	
	II-276	5g(D), 3g(BB)*, 3g(KK)*, 4g(HH)*, 5g(I)*, 5g(J)*
	JJ-277	3g(UU), 4g(GG), 1g(DD)*, 3g(WW)*, 6g(JJ)*, 7g(HH)*
	KK-332	3g(H), 1g(H)*, 1g(JJ)*, 7g(H)*
	LL-275	3g(P)*, 6g(JJ)*
	MM-275	6g(KK), 7g(I), 3g(XX)* 4g(K)*, 6g(I)*
1a(I)*	NN-255	4g(LL), 1g(LL)*, 1g(MM)* 5g(DD)*
7a(O)	OO-17	6g(MM), 1g(NN)*, 1g(II)*, 5g(F)*, 7g(JJ)*

Task/Skill Distribution Within the
Low Angle Pop-Up

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	A-47	
	B-247	
1a(B)*, 1a(P)*	C-332	1g(B)*, 2g(Z)*, 3g(PP)*, 5g(W)*, 7g(C)*
	D-270	
	E-280	5g(N), 2g(E)*, 2g(W)*, 6g(V)*, 7g(E)*
	F-260	1g(S), 4g(S), 6g(R)
1a(T)*, 4a(A)*	G-132	
	H-332	2g(KK), 1g(H)*, 1g(JJ)*, 7g(H)*
1a(AA)*, 4a(B)*	I-275	5g(Q), 1g(I)*, 2g(I)*, 6g(I)*
1a(CC), 1a(AA)	J-275	5g(P), 7g(LL)
3a(P)*, 3a (I), 3a(N)	K-257	3g(JJ), 6g(W), 6g(BB)
	L-252	7g(N), 1g(N)*, 2g(N)*, 4g(N)*
9a(A)*	M-287	1g(O)*, 5g(S)*, 6g(O)* 7g(O)*
5a(A)*, 7a(A)*, 8a(B)	N-327	2g(O), 1g(P)*, 4g(C)*, 5g(C)*
	O-269	4g(D)*
	P-275	
1a(W)*	Q-20	6g(F)*
	R-372	1g(G)*, 7g(G)*
5a(F)*, 5a(K)*, 7a(G)*, 8a(K)*, 9a(M)*	S-337	1g(W), 6g(T), 4g(U)*, 2g(U)*, 4g(II)*
1a(U)*, 7a(D)*	T-200	
5a(H)*, 6g(A)*, 1a(R)	U-280	2g(Y), 4g(V)*, 5g(O)*
	V-17	3g(NN)
3a(F)	W-280	
	X-257	

Task/Skill Distribution Within the
Low Angle Pop-Up

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	Y-217	3g(DD)*, 5g(EE)*
	Z-377	
	AA-277	
5a(M)*, 7a(K)*, 8a(S)*, 9a(L)*	BB-276	3g(KK), 5g(I), 2g(II)*, 4g(HH)*, 5g(D)*, 5g(J)*
1a(K)	CC-16	
	DD-217	3g(Y)*, 3g(EE)*, 5g(EE)*
	EE-217	3g(DD)*, 5g(EE)*
5a(F)*, 5a(K)*, 4a(O), 7a(G)*, 9a(M)*	FF-337	4g(II), 1g(W)*, 4g(U)*, 6g(T)*
	GG-280	5g(BB)
5a(O), 6a(N), 7a(M), 9a(AA)	HH-280	5g(CC)
1a(D)*, 1a(Z), 3a(K), 3a(L)*, 5a(I)*, 7a(Q)*	II-277	3g(MM)*
3a(I)*, 3a(N)*, 3a(P)	JJ-257	6g(W), 6g(BB), 1g(Z)*, 7g(Z)*
5a(M)*, 7a(K)*, 8a(S)*, 9a(L)*	KK-276	3g(BB), 5g(I), 2g(II)*, 5g(D)*
1a(R)*, 1a(V)*, 6a(G), 2g(V)*, 4a(P)*	LL-280	3g(U)
1a(D), 3a(L), 3a(M), 7a(O), 1a(Z)*, 3a(K)*, 5a(I)*	MM-277	3g(II)*
	NN-17	1g(K)*, 2g(K)*, 3g(V)*, 4g(K)*, 6g(K)*
	OO-257	
	PP-332	2g(Z), 1g(B)*, 4g(P)*, 5g(W)*
	QQ-252	1g(CC)*, 1g(DD)*, 6g(AA)* 7g(BB)*, 7g(DD)*
	RR-252	
	SS-292	4g(CC)*, 6g(EE)*
	TT-271	7g(GG)*

Task/Skill Distribution Within the
Low Angle Pop-Up

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	UU-277	2g(JJ), 4g(GG), 1g(GG)*, 6g(GG)*, 7g(HH)*
6a(O)*, 7a(F)*, 8a(Q)*	VV-256	1g(M), 7g(M), 6g(H)*, 2g(M)*, 6g(M)*
	WW-332	1g(JJ)*, 2g(KK)*, 3g(H)*
1a(AA)*, 1a(CC)*	XX-275	1g(I), 2g(I), 3g(YY), 4g(I), 4g(JJ), 4g(KK), 6g(I)
1a(AA)*, 1a(CC)*	YY-275	1g(I), 2g(I), 3g(XX), 4g(I), 4g(JJ), 4g(KK), 6g(I)
	ZZ-15	7g(NN), 6g(LL)*
	AAA-12	4g(MM), 7g(OO)*

Task/Skill Distribution Within
The Low Angle Strafe

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	A-287	1g(A), 2g(B), 6g(B), 7g(A)
	B-247	1g(B)
	C-327	1g(P), 2g(C), 6g(C)
	D-[illegible]	3g(O)*
	E-275	1g(J), 2g(J), 4g(J), 6g(J), 7g(J)
	F-260	1g(F)*, 2g(F)*, 6g(F)*, 7g(F)*
	G-292	6g(G)
5a(K)*, 8a(K)*	H-337	2g(H), 6g(H), 1g(W)*, 2g(U)*, 3g(S)*, 6g(T)*
	I-275	1g(I), 2g(I), 3g(XX), 3g(YY), 4g(JJ), 4g(KK), 6g(I), 7g(I)*
	J-275	Same skills as I (above)
	K-17	1g(K), 2g(K), 6g(G), 7g(K)
	L-32	7g(L)
6a(P)	M-256	1g(M), 2g(M), 6g(M), 7g(M)*
	N-252	1g(N), 2g(N)
	O-287	
	P-332	7g(CC), 1g(BB)*, 2g(Z)*, 3g(PP)*, 5g(W)*, 6g(Y)*, 7g(C)*
	Q-270	6g(P), 5g(M)*
2a(U), 3a(J), 5a(C), 5a(G), 5a(L), 5a(N), 7a(H)	R-280	2g(S), 4g(V), 6g(Q), 6g(U)
5a(E)*, 6a(I)*	S-260	1g(S), 3g(F), 6g(R), 1g(F)*, 7g(F)*, 7g(S)*
	T-137	6g(S)

Task/Skill Distribution Within The Low Angle Strafe

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
5a(F), 7a(G), 9a(M), 1a(X)*, 4a(O)*, 5a(K)*, 8a(K)*	U-337	1g(W)*, 2g(U)*, 3g(S)*, 3g(FF)*, 4g(II)*, 6g(T)*
2a(U), 3a(J), 5a(C), 5a(G), 5a(L), 5a(N), 7a(H)	V-280	2g(S), 4g(N), 6g(Q), 6g(U)
2a(M), 4a(G), 5a(D), 5a(H), 8a(H)	W-280	2g(R)
9a(H)*	X-257	2g(Y), 3g(OO)*
	Y-257	1g(AA)*, 6g(X)*, 7g(AA)*
	Z-337	
	AA-272	6g(Z)
	BB-257	
	CC-292	3g(SS)*, 4g(DD)*, 4g(EE)*, 6g(EE)*
	DD-292	4g(EE), 4g(CC)*
	EE-292	4g(DD), 4g(CC)*
	FF-31	1g(FF)
	GG-277	2g(JJ), 3g(UU), 1g(GG)*, 6g(GG)*, 7g(HH)*
7a(K)*, 8a(S)*, 9a(L)*	HH-276	5g(J), 2g(II)*, 3g(BB)*, 3g(KK)*, 5g(D)*, 5g(I)*
1a(X)*, 3a(E)*, 4a(O), 5a(F)*, 7a(G)*, 9a(M)*	II-337	3g(FF), 1g(W)*, 3g(S)*, 4g(U)*, 6g(T)*
	JJ-275	1g(I), 2g(I), 3g(XX), 3g(YY), 4g(I), 4g(KK), 6g(I)
	KK-275	1g(I), 2g(I), 3g(XX), 3g(YY), 4g(I), 4g(JJ), 6g(I)
1a(I)*	LL-255	2g(NN), 1g(LL)*, 1g(MM)*, 5g(DD)*
	MM-12	3g(AAA), 7g(OO)*

Task/Skill Distribution Within The Nuclear LADD

AIR/AIR SKILLS *kindred skills	Skill Slot	AIR/GROUND SKILLS *kindred skills
	A-207	
9a(I)*	B-92	7g(KK)
	C-192	
	D-276	2g(II), 4g(HH)*, 5g(I)* 5g(J)*
	E-251	
	F-17	1g(II)*, 7g(JJ)*
5a(A)*, 7a(A)*, 8a(B)	G-327	2g(O)*, 3g(N)*
	H-267	
	I-276	3g(BB), 3g(KK), 4g(HH)*, 5g(J)*
	J-276	4g(HH), 3g(BB)*, 3g(KK)*
	K-257	
	L-327	7g(P), 1g(P)*, 2g(C)*, 4g(C)*, 6g(C)*
	M-270	
	N-280	3g(E), 2g(N)*, 6g(V)*
2a(M), 5a(H), 5a(P), 8a(H)	O-280	2g(R), 4g(W)
1a(CC)	P-275	3g(J), 7g(LL), 1g(I)*, 2g(I)*, 6g(I)*
	Q-275	3g(I), 3g(J)*, 7g(LL)*
	R-12	2g(CC)*
	S-287	3g(M)*
	T-207	
	U-272	2g(L), 1g(L)*, 6g(L)*
	V-252	1g(N), 2g(N), 4g(N), 3g(L)*, 7g(N)*
1a(B)	W-332	1g(BB)
	X-212	
	Y-195	
	Z-280	

Task/Skill Distribution Within
The Nuclear LADD

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	AA-217	
	BB-280	3g(GG)
5a(O), 6a(N), 7a(M), 9a(AA)	CC-280	3g(HH)
1a(I)	DD-255	1g(LL), 1g(NN), 2g(NN)*, 4g(LL)*
	EE-217	3g(EE)*, 3g(DD)*

Task/Skill Distribution Within The Low Angle Dive Bomb

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
9a(A)	A-287	2g(A), 1g(A)*, 1g(O)*, 6g(O)*, 7g(O)*, 7g(A)*
	B-287	1g(A), 2g(B), 4g(A), 7g(A)
	C-327	1g(P), 2g(C)
	D-275	
	E-280	1g(Y), 1g(E)*, 2g(E)*, 7g(E)*
	F-20	1g(F)*, 2g(F)*, 4g(F)*, 7g(F)*
	G-292	2g(G), 4g(G)
	H-337	2g(H), 4g(H)
	I-275	1g(I), 2g(I), 3g(XX), 3g(YY), 4g(I), 4g(JJ), 4g(KK), 7g(I)*
	J-275	1g(J), 2g(J), 4g(E), 4g(J), 7g(J)
	K-17	1g(K), 2g(K), 4g(K), 6g(K), 7g(K)
	L-272	2g(L)*
8a(Q)	M-256	1g(M), 2g(M), 4g(M), 7g(M)
	N-252	
1a(B)	O-278	1g(O)*, 7g(O)*
	P-270	4g(Q), 5g(M)*
2a(U), 3a(J), 5a(C), 5a(G), 5a(L), 5a(N), 7a(H)	Q-280	2g(S), 4g(R), 4g(V) 6g(U)
	R-260	1g(S), 3g(F), 4g(S), 6g(R)*
	S-137	4g(T)
5a(K)	T-337	1g(W), 3g(S), 2g(H)*, 4g(H)*, 6g(H)*
2a(U), 3a(J), 5a(C), 5a(G), 5a(L), 5a(N), 7a(H)	U-280	2g(S), 4g(R), 4g(V), 6g(Q)

Task/Skill Distribution Within The Low Angle Dive Bomb

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	V-280	2g(W)
3a(P)	W-257	3g(JJ), 6g(BB), 1g(Z)*, 7g(Z)*
	X-257	4g(Y)*, 7g(AA)*
1a(B)	Y-332	1g(BB), 5g(W), 6g(O)
1a(H)*	Z-272	4g(AA), 2g(FF)*
	AA-252	1g(CC), 1g(DD)*, 2g(DD)*, 7g(BB)*, 7g(DD)*
3a(P)*	BB-257	1g(Z)*, 3g(JJ)*, 6g(N)*, 7g(Z)*
9a(R)*	CC-297	
2a(A)*	DD-292	
	EE-292	3g(SS)*, 4g(CC)*
	FF-32	
	GG-277	2g(JJ)*, 3g(UU)*, 4g(GG)*
7a(F)	HH-256	1g(M)*, 3g(VV)*, 7g(M)*
	II-92	
	JJ-275	2g(LL)*, 3g(P)*
	KK-275	2g(MM), 7g(I)
	LL-15	3g(ZZ)*, 7g(NN)*
7a(O)	MM-17	2g(OO)

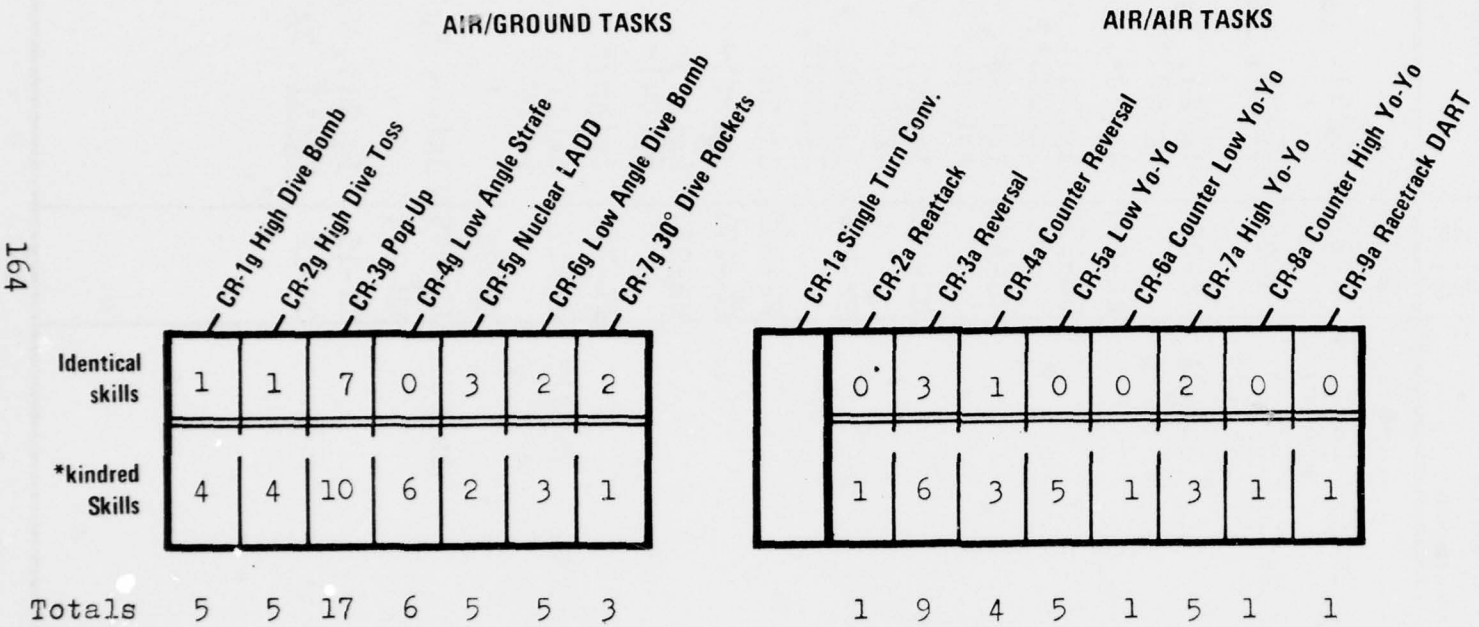
Task/Skill Distribution Within The 30° Dive Rockets

AIR/AIR SKILLS *kindred skills	Skill / Slot	AIR/GROUND SKILLS *kindred skills
	A-287	1g(A), 2g(B), 4g(A), 6g(B)
	B-287	1g(A), 4g(A), 6g(B), 7g(A)
	C-332	2g(Z), 1g(BB)*, 3g(PP)*, 4g(P)*, 5g(W)*, 6g(Y)*
	D-270	
	E-280	2g(E), 1g(E)*, 2g(E)*, 6g(E)*
	F-260	1g(F), 2g(F)*, 4g(F)*, 6g(F)*
	G-372	1g(G), 3g(R)*
	H-332	1g(H), 1g(JJ)*, 2g(KK)*, 3g(H)*
	I-275	2g(MM), 6g(KK)
	J-275	1g(J), 2g(J), 4g(E), 4g(J), 6g(J)
	K-17	1g(K), 2g(K), 4g(K), 6g(K), 7g(K)
	L-32	4g(L)*
	M-256	1g(M), 2g(M), 4g(M), 6g(M)
	N-252	3g(L)
9a(A)	O-287	1g(O), 2g(A)*, 3g(M)*, 6g(A)*, 6g(O)*
5a(A)*, 7a(A)*	P-327	5g(L), 1g(P)*, 2g(C)*, 4g(C)*, 6g(C)*
	Q-270	
	R-269	
5a(J)*, 9a(G)*, 5a(E), 6a(I)	S-260	1g(S)*, 1g(F)*, 2g(F)*, 3g(F)*, 4g(S)*, 6g(R)*, 7g(F)*
	T-272	
	U-317	
	V-317	

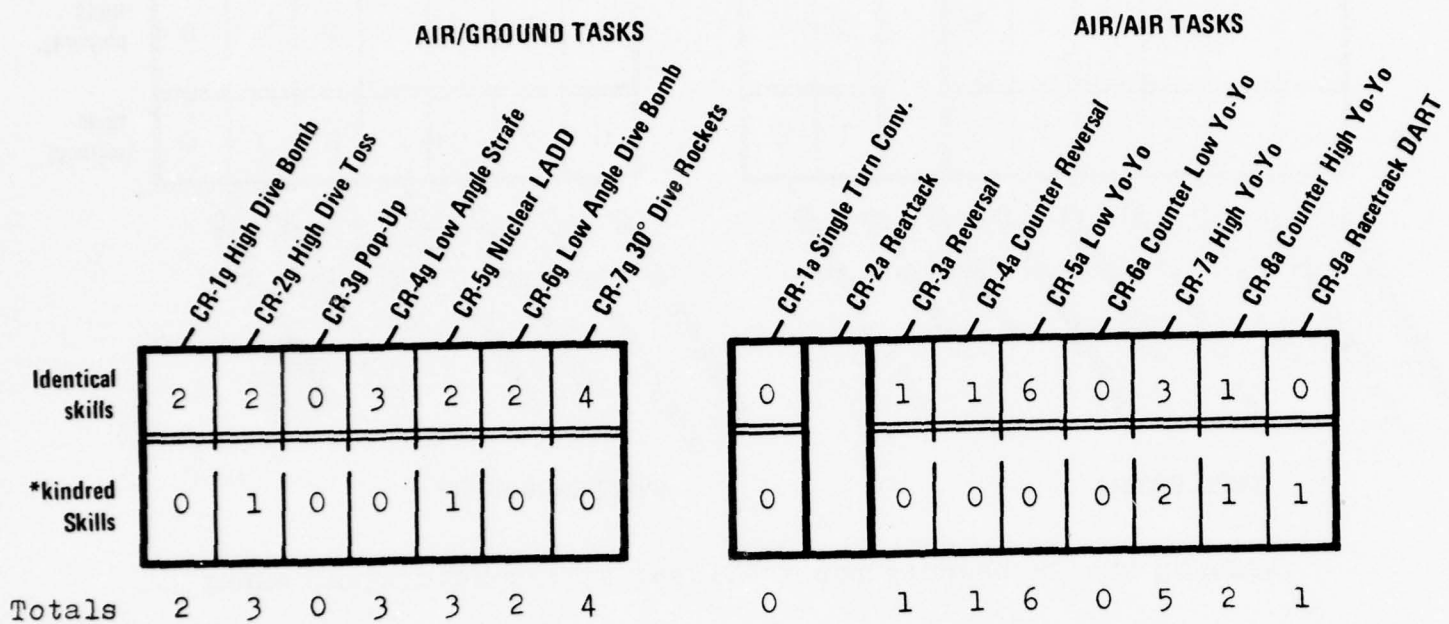
Task/Skill Distribution Within The 30° Dive Rockets

AIR/AIR SKILLS *kindred skills	Skill Slot	AIR/GROUND SKILLS *kindred skills
9a(P)	W-357	
7a(E), 2a(I), 2a(K), 7a(L)*	X-279	5g(O), 7g(Y)
7a(E), 2a(I), 2a(K), 7a(L)*	Y-279	5g(O), 7g(X)
3a(P)*	Z-257	1g(Z), 3g(JJ)*, 6g(W)*, 6g(BB)*
	AA-257	4g(Y)*, 6g(X)*
	BB-252	1g(DD), 2g(DD), 7g(EE), 1g(CC)*, 6g(AA)
	CC-332	1g(BB)*, 2g(Z)*, 3g(PP)*, 4g(P)*, 5g(W)*, 6g(Y)*
	DD-252	1g(CC), 6g(AA), 1g(DD)*, 2g(DD)*
	EE-252	1g(DD), 2g(DD), 7g(BB), 1g(CC)*, 6g(AA)*
	FF-252	1g(EE)
	GG-271	3g(TT)*
	HH-277	2g(JJ)*, 3g(UU)*, 4g(GG)*, 6g(GG)*
	II-36	1g(HH)*
7a(O)*	JJ-17	1g(II), 2g(OO)*, 5g(F)*, 6g(MM)*
	KK-92	
1a(CC)	LL-275	3g(J), 5g(P)
	MM-274	
	NN-15	3g(ZZ), 6g(LL)*
	OO-12	7g(L), 3g(AAA)*, 4g(M)*

Tasks Containing Skills Identical and Kindred to the Single Turn Conversion



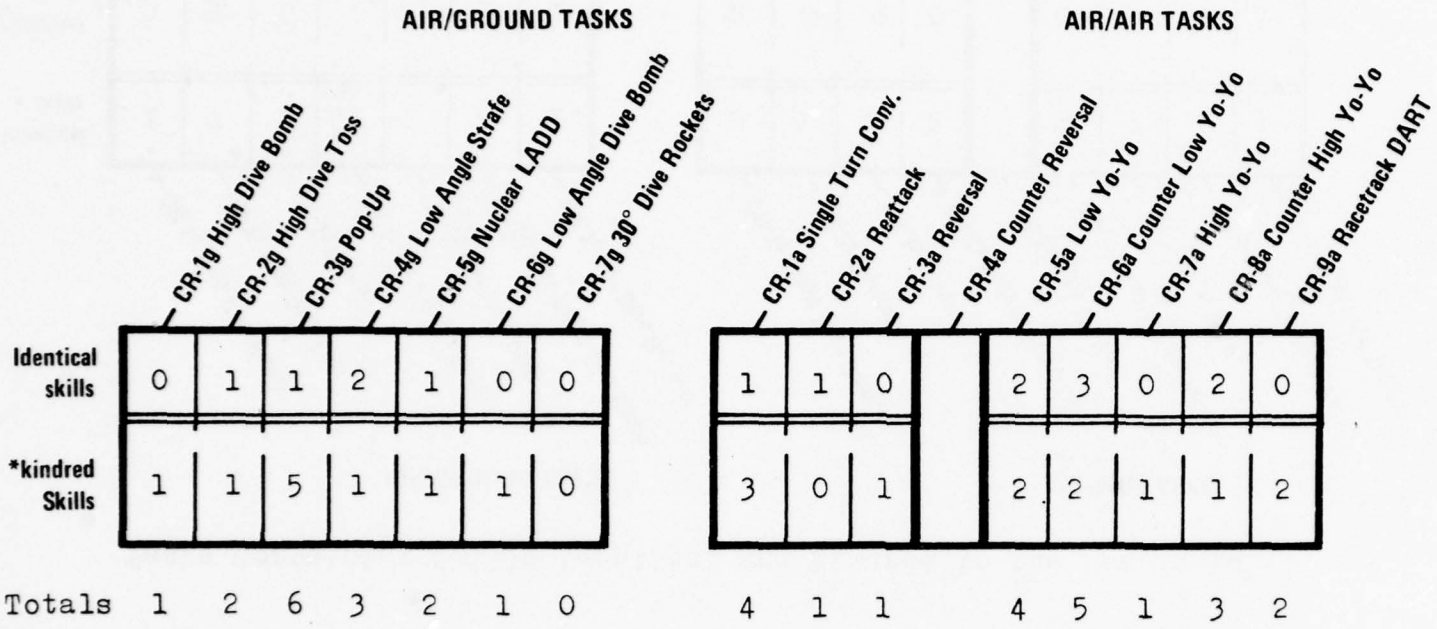
Tasks Containing Skills Identical and Kindred to the Reattack



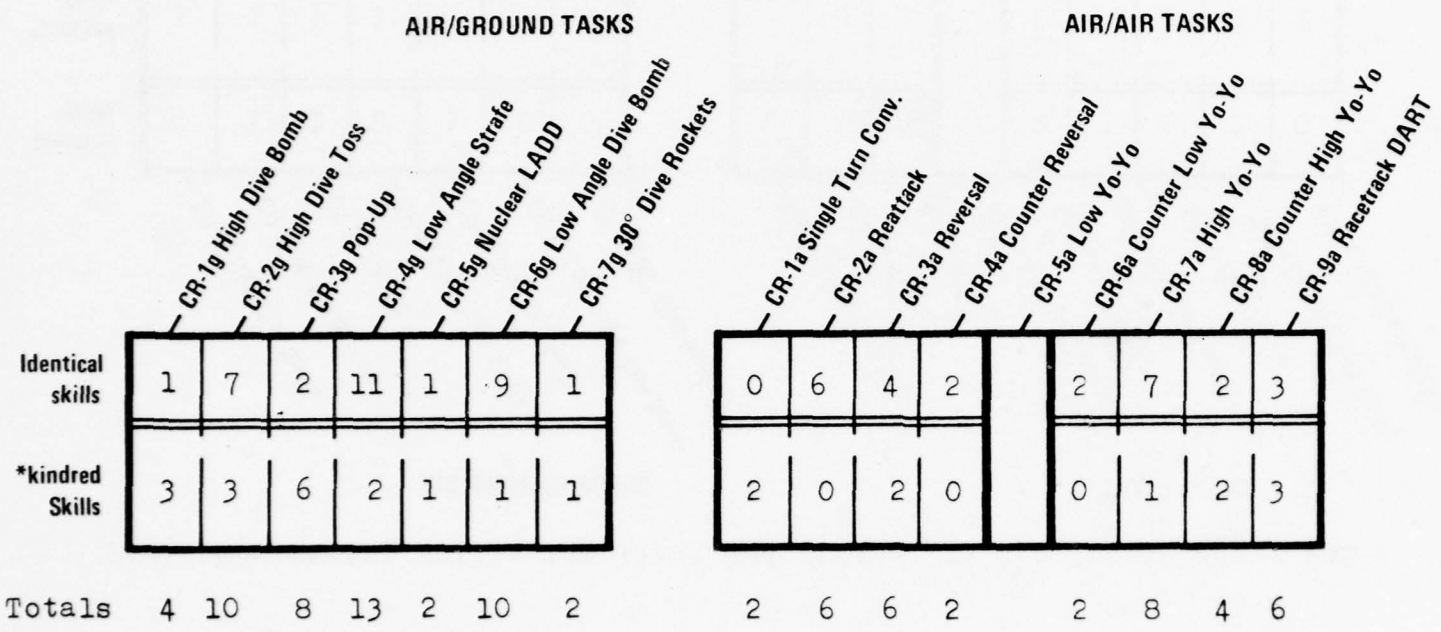
Tasks Containing Skills Identical and Kindred to the Reversal

	AIR/GROUND TASKS							AIR/AIR TASKS								
	CR-1g High Dive Bomb	CR-2g High Dive Toss	CR-3g Pop-Up	CR-4g Low Angle Strafe	CR-5g Nuclear LADD	CR-6g Low Angle Dive Bomb	CR-7g 30° Dive Rockets	CR-1a Single Turn Conv.	CR-2a Reattack	CR-3a Reversal	CR-4a Counter Reversal	CR-5a Low Yo-Yo	CR-6a Counter Low Yo-Yo	CR-7a High Yo-Yo	CR-8a Counter High Yo-Yo	CR-9a Racetrack DART
Identical skills	0	1	8	2	0	4	0	3	1		0	4	2	3	1	0
*kindred Skills	0	0	4	1	0	4	0	3	0		1	2	1	0	1	2
Totals	0	1	12	3	0	8	0	6	1		1	6	3	3	2	2

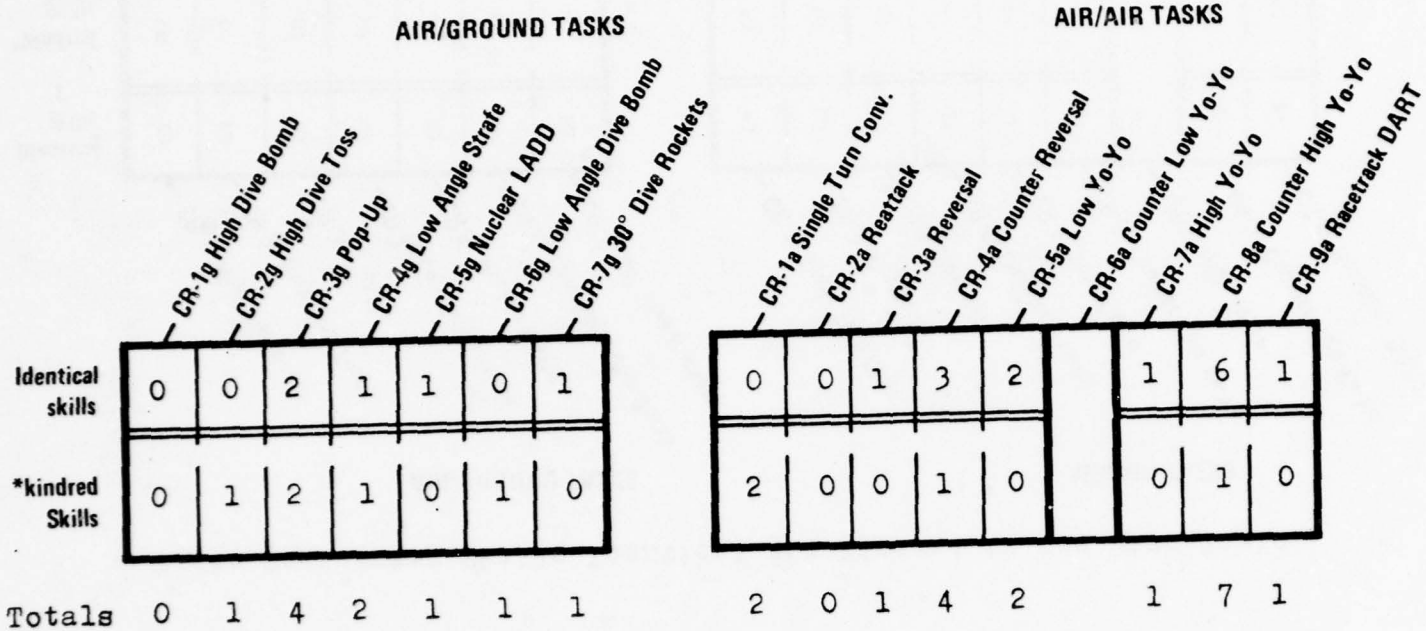
Tasks Containing Skills Identical and Kindred to the Counter Reversal



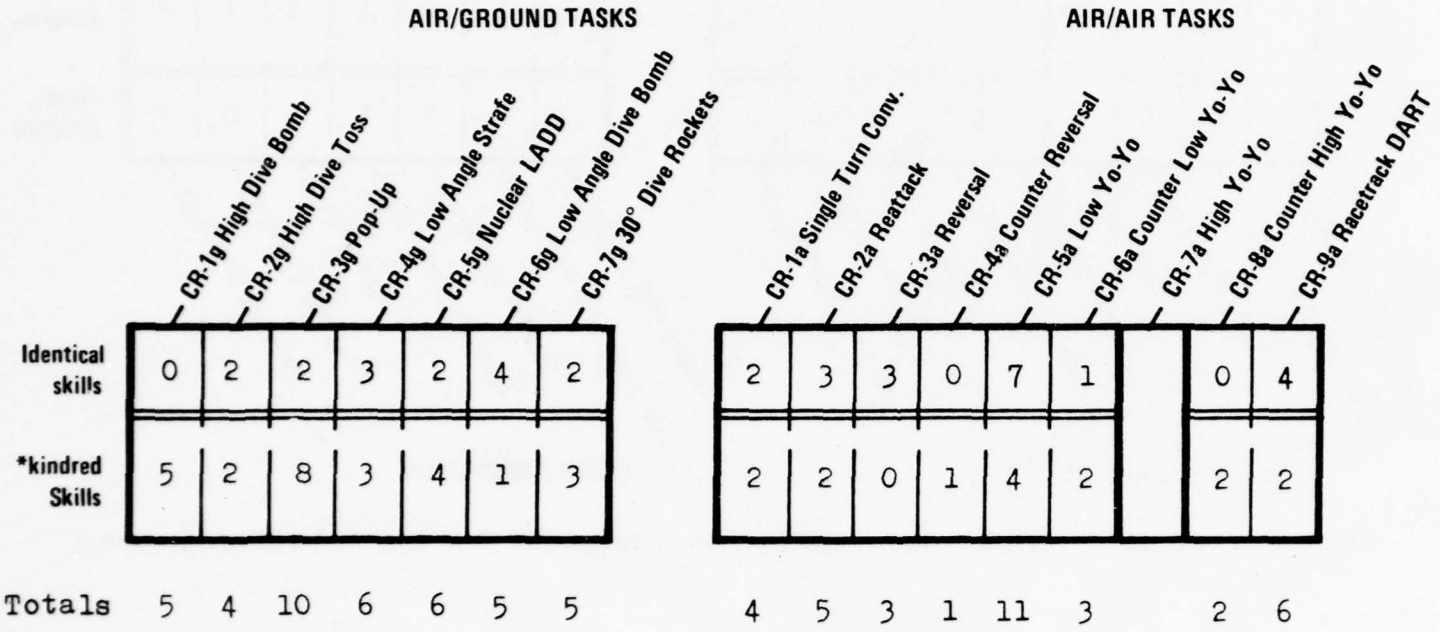
Tasks Containing Skills Identical and Kindred to the Low Yo-Yo



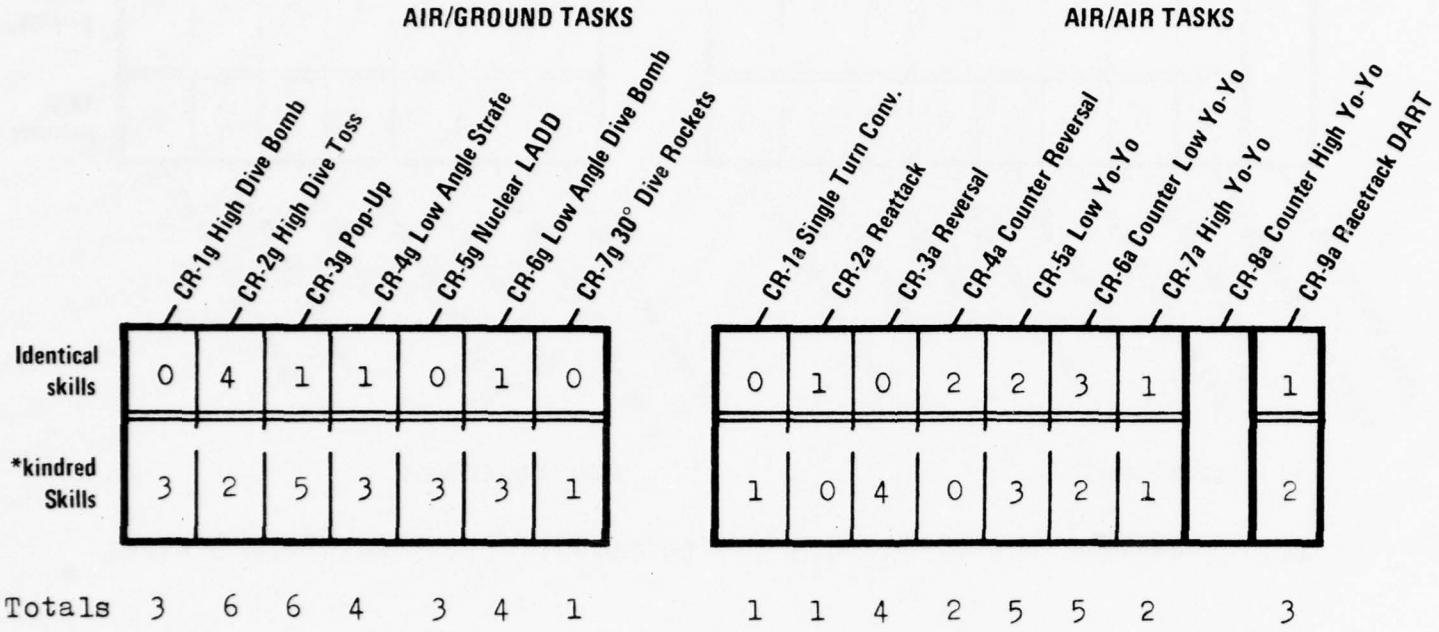
Tasks Containing Skills Identical and Kindred to the Counter Low Yo-Yo



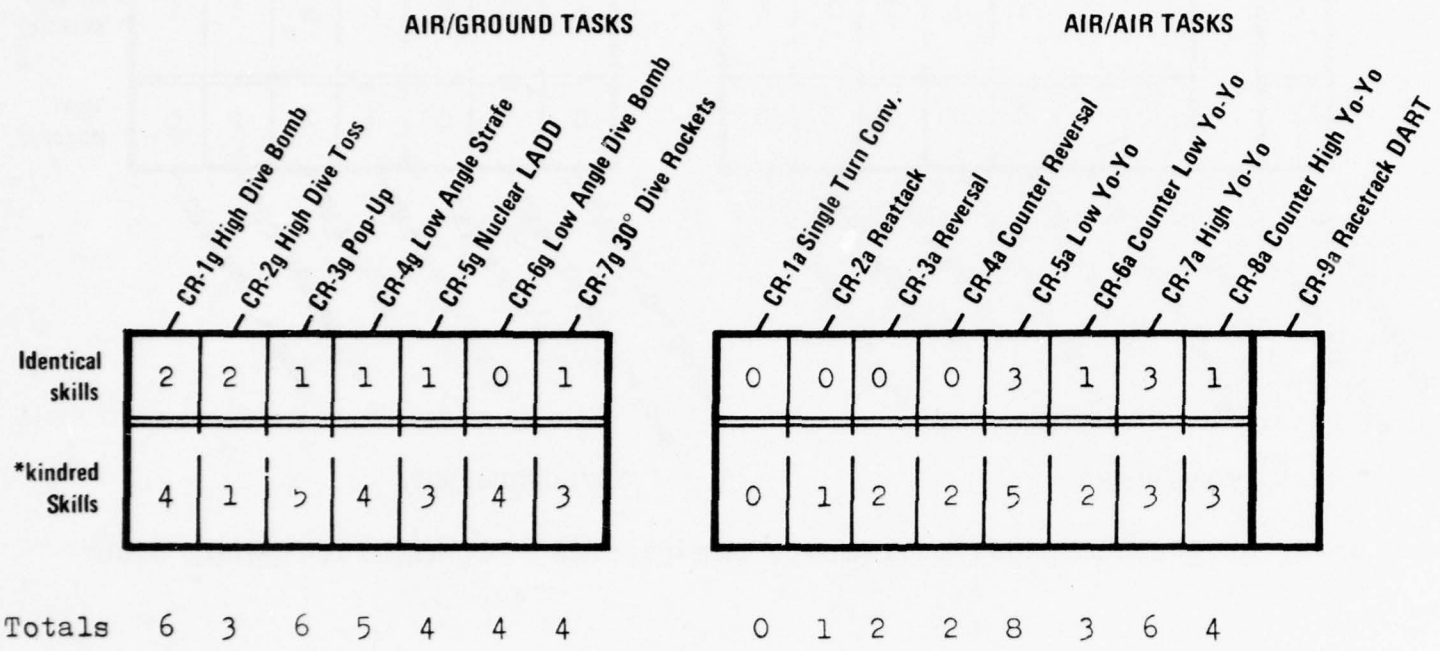
Tasks Containing Skills Identical and Kindred to the High Yo-Yo



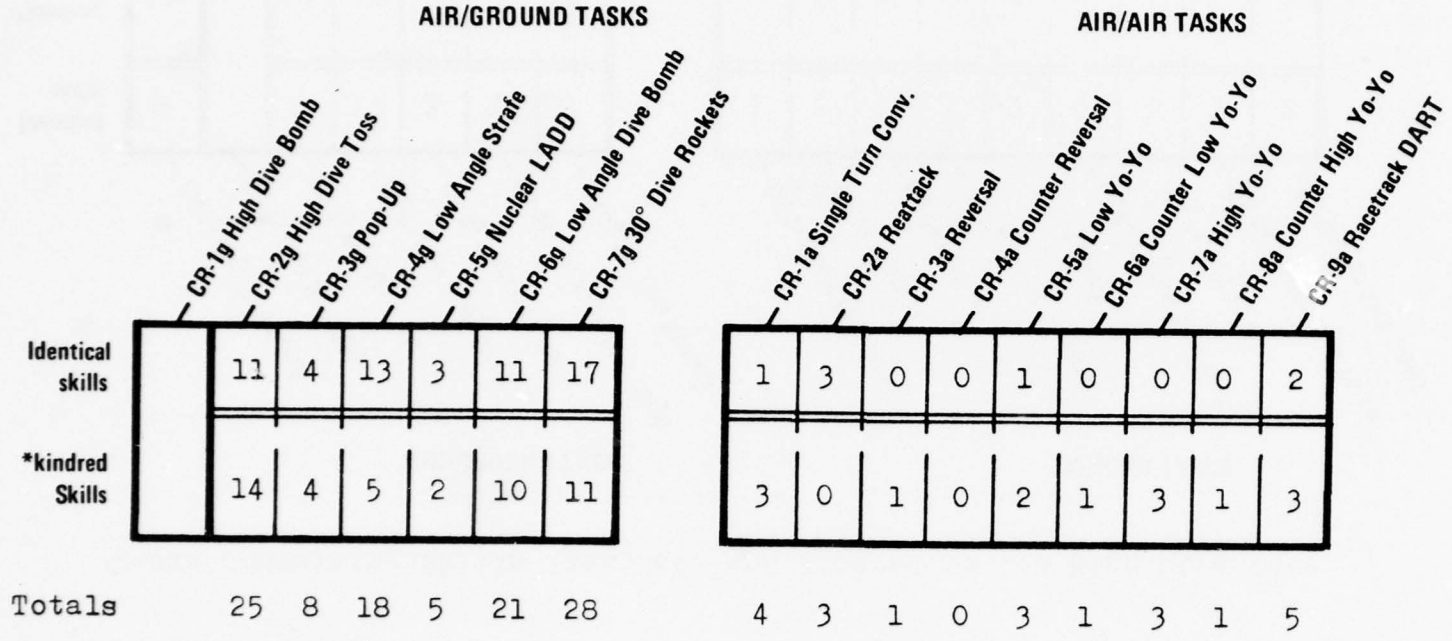
Tasks Containing Skills Identical and Kindred to the Counter High Yo-Yo



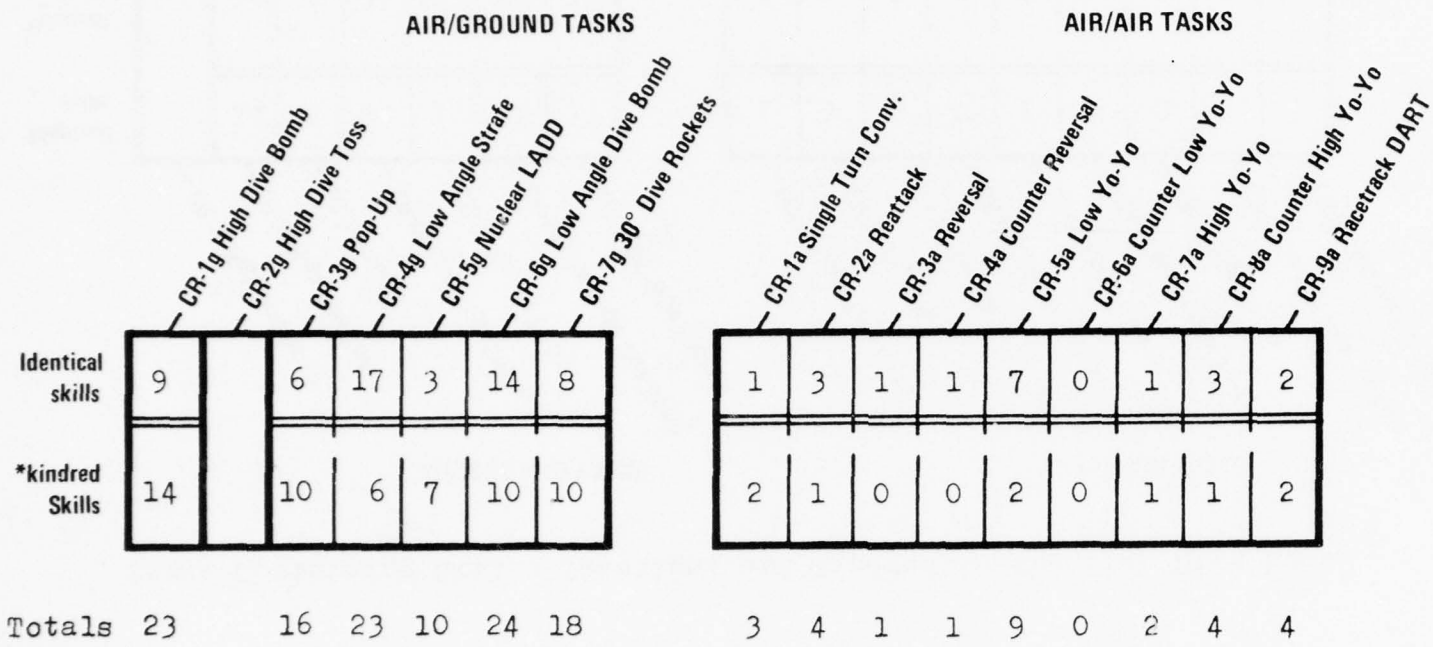
Tasks Containing Skills Identical and Kindred to the Racetrack DART



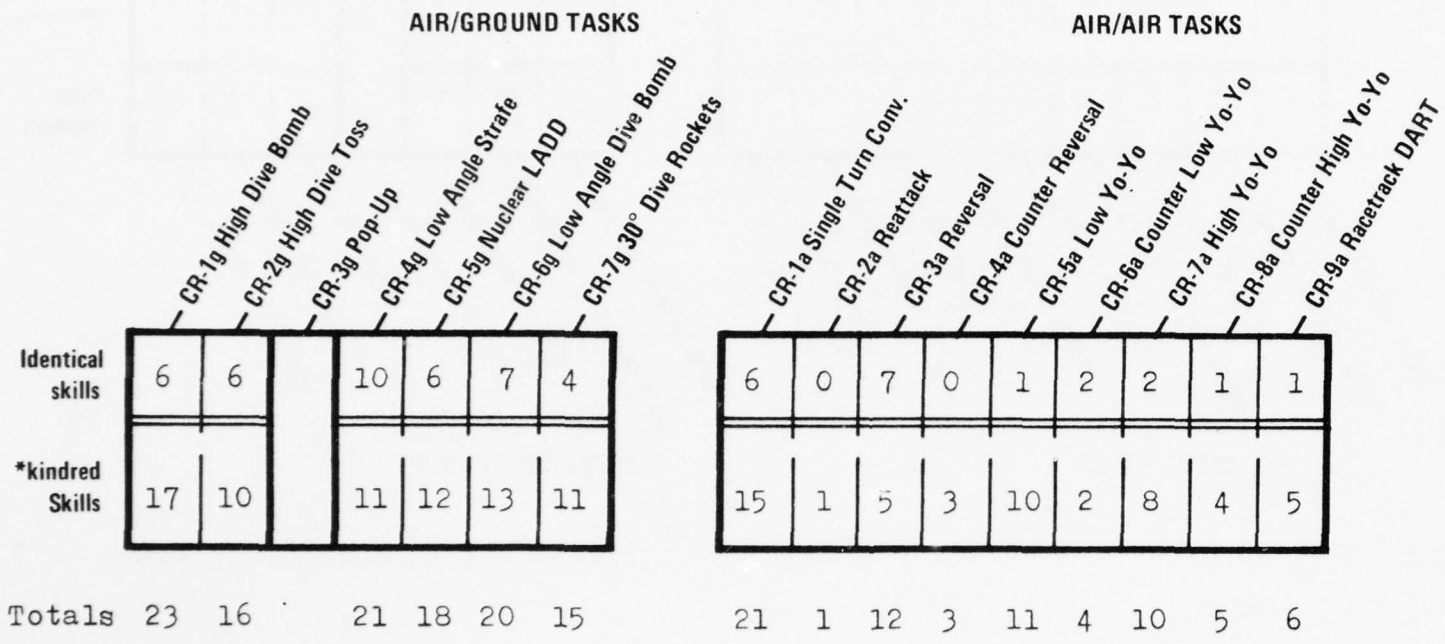
Tasks Containing Skills Identical and Kindred to the High Dive Bomb



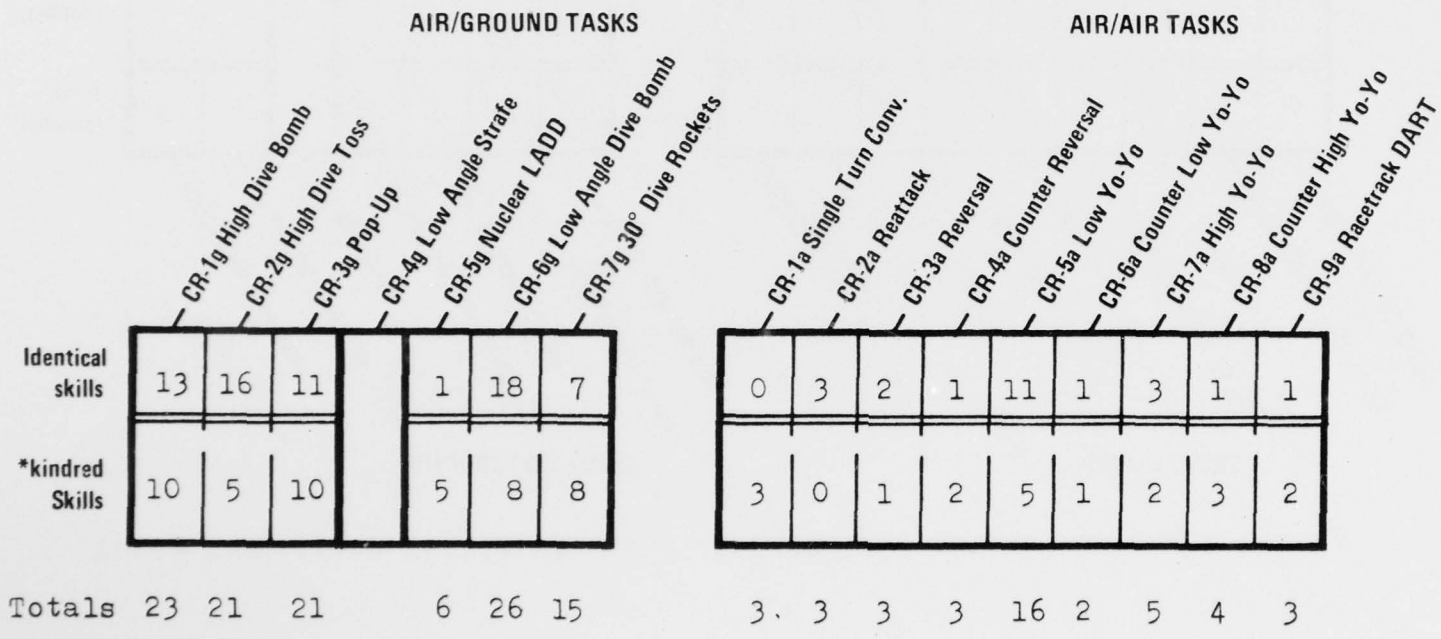
Tasks Containing Skills Identical and Kindred to the High Dive Toss



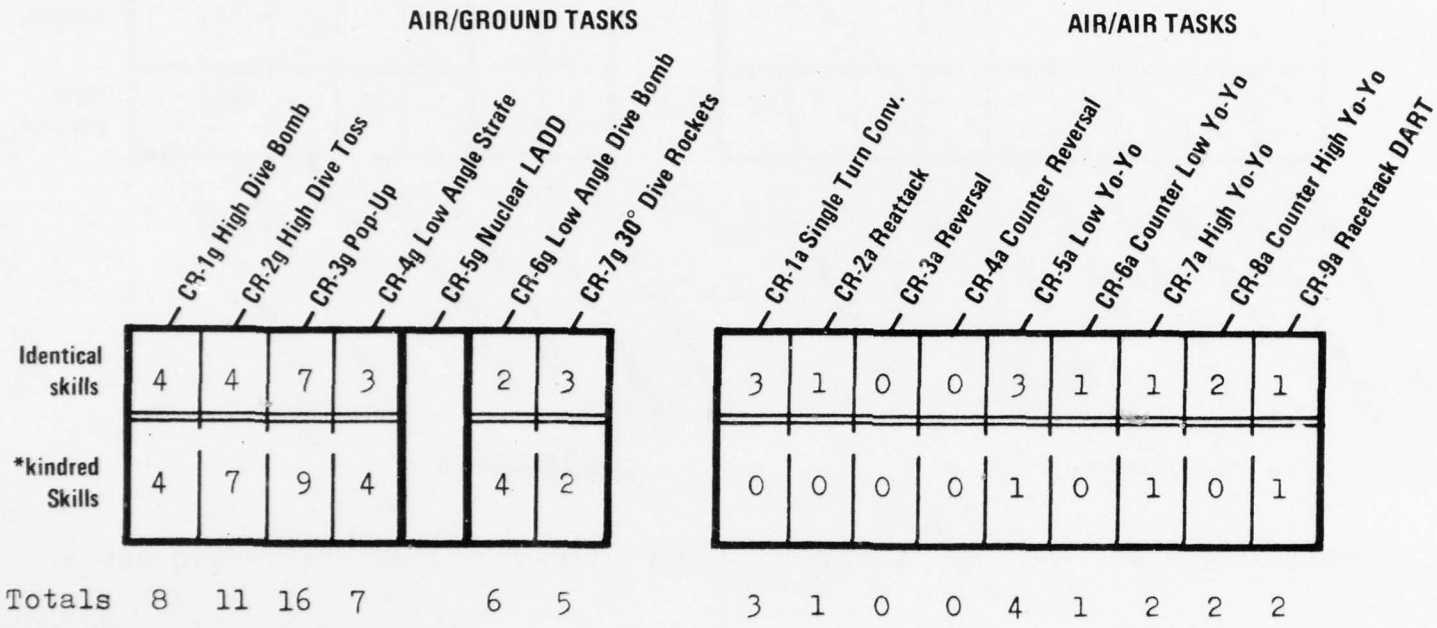
Tasks Containing Skills Identical and Kindred to the Low Angle Pop-Up



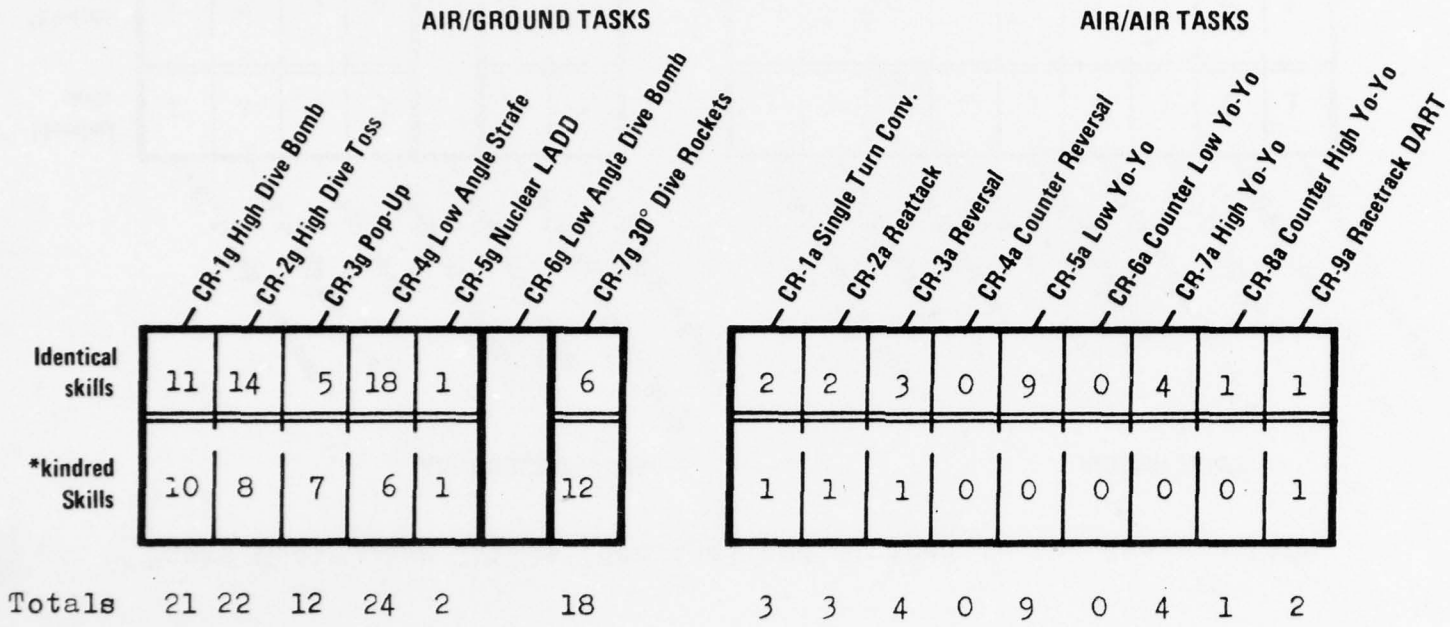
Tasks Containing Skills Identical and Kindred to the Low Angle Strafe



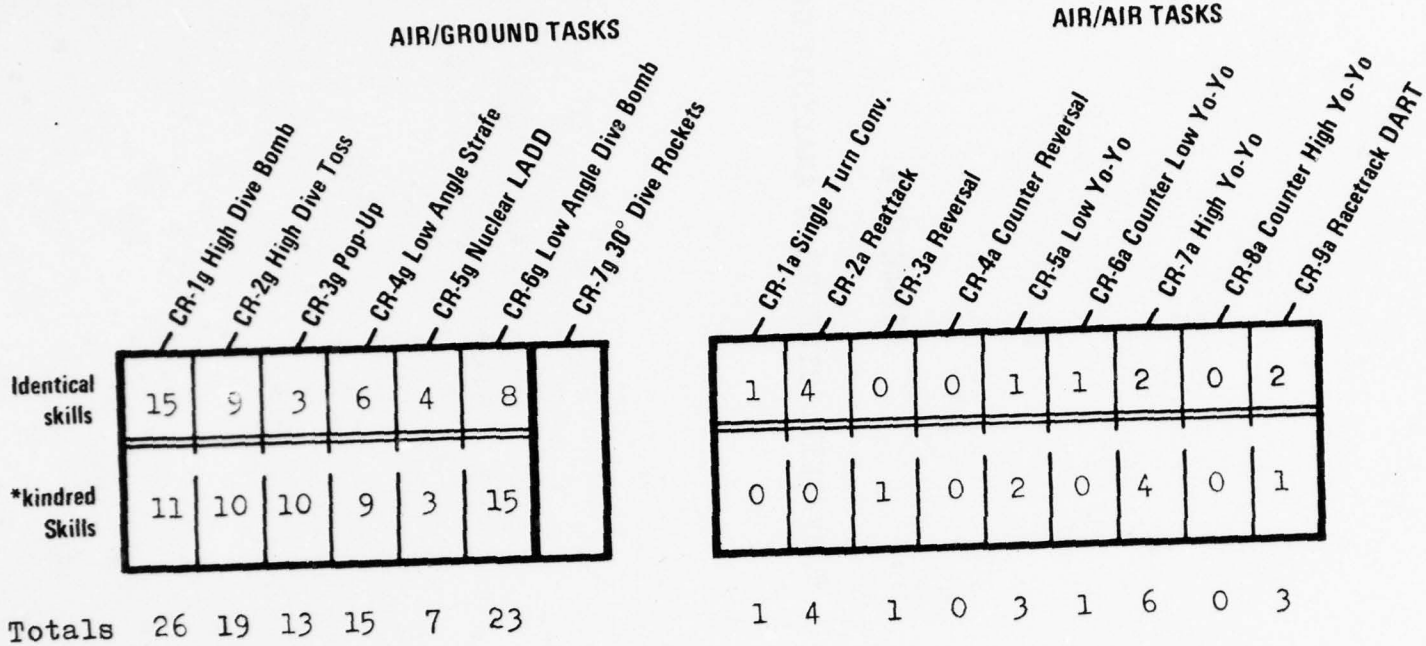
Tasks Containing Skills Identical and Kindred to the Nuclear LADD



Tasks Containing Skills Identical and Kindred to the Low Angle Dive Bomb



Tasks Containing Skills Identical and Kindred to the 30° Dive Rockets



APPENDIX E

TASK/SKILL DIFFICULTY ANALYSIS DATA

Task/Skill Difficulty Analysis for Single Turn Conversion
Task Difficulty Index: 56.97 Skill Value Range: 39.8-71.0

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	9	7.5	2.5	3.3	6	7	6	4	45.3
B	9	7.5	3.3	6.7	10	7	4	4	51.5
C	9	7.5	1.6	5.	6	10	8	10	57.1
D	10	10.	6.6	10.	10	10	6	4	66.6
E	10	10.	5.	10.	6	7	6	10	64.0
F	8	7.5	3.3	1.7	10	10	4	4	48.5
G	10	10.	5.	5.	10	10	6	10	66.0
H	8	7.5	5.	10.	10	10	6	4	60.5
I	8	7.5	5.	10.	10	7	6	10	63.5
J	10	10.	4.2	5.	6	10	2	2	49.2
K	10	10.	3.3	10.	6	7	2	2	50.3
L	10	10.	3.3	10.	6	7	2	2	50.3
M	10	10.	2.5	3.3	6	7	6	4	48.8
N	10	10.	5.	3.3	10	7	4	4	53.3
O	8	7.5	1.6	1.7	6	7	4	4	39.8
P	9	7.5	1.6	3.3	10	7	4	4	46.4
Q	7	5.	1.6	10.	10	10	6	10	59.6
R	10	10.	5.	10.	10	10	6	10	71.0
S	10	10.	5.	10..	6	7	6	10	64.0
T	8	7.5	4.2	1.7	6	7	4	4	42.4
U	10	10.	6.6	5.	6	10	6	10	63.6
V	8	7.5	4.2	10.	10	10	6	10	65.7
W	10	10.	3.3	6.7	10	7	4	4	55.0
X	10	10.	5.8.	10.	6	7	6	10	64.8
Y	7	5.	.8	10.	10	10	6	10	58.8
Z	10	10.	5.8	10.	10	10	6	4	65.8
AA	8	7.5	5.	10.	6	10	6	10	62.5
BB	10	10.	3.3	1.7	6	10	6	4	51.0
CC	8	7.5	5.	10.	10	10	6	10	66.5
DD	10	10.	5.8	10.	10	10	4	4	63.8
EE	10	10.	5.	10.	6	10	6	4	61.0
FF	10	10.	5.8	8.3	10	10	5	4	63.1

Task/Skill Difficulty Analysis for Reattack
Task Difficulty Index: 66.87 Skill Value Range: 53.5-75.8

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	9	7.5	3.3	8.3	10	7	6	4	55.1
B	9	7.5	3.3	6.7	10	7	6	4	53.5
C	9	7.5	3.3	10.	10	7	9	4	59.8
D	9	7.5	4.2	5.	6	10	8	10	59.7
E	10	10.	6.6	5.	10	10	7	10	68.6
F	10	10.	6.6	10.	10	10	7	4	67.6
G	10	10.	6.6	10.	10	10	7	4	67.6
H	10	10.	6.6	10.	10	10	7	10	73.6
I	10	10.	6.6	10.	10	10	6	8	70.6
J	10	10.	5.8	10.	10	10	7	10	72.8
K	10	10.	6.6	10.	10	10	6	8	70.6
L	10	10.	5.8	10.	10	10	7	10	72.8
M	10	10.	6.6	10.	10	10	6	10	72.6
N	10	10.	5.8	10.	10	10	7	10	72.8
O	10	10.	6.6	10.	6	10	7	10	69.6
P	10	10.	7.5	8.3	10	7	7	4	63.8
Q	10	10.	9.1	6.7	10	7	6	4	62.8
R	10	10.	5.8	10.	10	7	7	4	63.8
S	10	10.	7.5	8.3	10	7	6	4	62.8
T	10	10.	6.6	8.3	10	7	7	4	62.9
U	10	10.	5.8	10.	10	10	6	10	71.8
V	10	10.	5.	10.	10	10	8	4	67.0
W	10	10.	5.8	10.	10	10	10	10	75.8

Task/Skill Difficulty Analysis for Reversal
Task Difficulty Index: 64.08 Skill Value Range: 54.2-74.0

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	10	10.	3.3	8.3	10	7	5	4	57.6
B	10	10.	3.3	10.	10	10	7	10	70.3
C	10	10.	5.	10.	10	10	9	10	74.0
D	10	10.	6.6	8.3	10	7	5	4	60.9
E	10	10.	2.5	6.7	10	7	4	4	54.2
F	10	10.	3.3	10.	10	10	8	10	71.3
G	10	10.	8.3	10.	10	10	6	4	68.3
H	10	10.	7.5	10.	6	10	6	4	63.5
I	10	10.	5.8	10.	10	7	6	4	62.8
J	10	10.	5.8	10.	10	10	6	10	71.8
K	10	10.	5.8	10.	10	10	6	4	65.8
L	10	10.	6.6	10.	10	10	6	4	66.6
M	10	10.	6.6	10.	10	10	6	4	66.6
N	10	10.	5.8	10.	10	7	6	4	62.8
O	8	7.5	5.	8.3	10	7	7	4	56.8
P	10	10.	7.5	10.	10	7	6	4	64.5
Q	8	7.5	5.8	10.	10	7	7	4	59.3
R	10	10.	7.5	5.	6	7	7	4	56.5

Task/Skill Difficulty Analysis for Counter Reversal
Task Difficulty Index: 61.45 Skill Value Range: 40.7-73.6

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	8	7.5	2.5	1.7	6	7	4	4	40.7
B	8	7.5	2.5	10.	10	10	6	10	64.0
C	10	10.	4.2	10.	10	10	8	4	66.2
D	8	7.5	4.2	10.	10	7	4	4	54.7
E	10	10.	5.8	8.3	10	7	4	4	59.1
F	10	10.	5.	10.	10	7	8	4	64.0
G	10	10.	6.6	10.	10	10	6	10	72.6
H	10	10.	6.6	10.	10	10	7	10	73.6
I	10	10.	6.6	1.7	6	10	4	4	52.3
J	10	10.	5.8	8.3	10	7	7	4	62.1
K	10	10.	5.8	5.	10	10	6	10	66.8
L	10	10.	6.6	10.	10	7	3	4	60.6
M	10	10.	5.	10.	10	7	3	4	59.0
N	10	10.	5.	10.	10	7	3	4	59.0
O	10	10.	4.2	6.7	10	7	4	4	55.9
P	10	10.	4.2	10.	10	10	6	10	70.2
Q	10	10.	7.5	10.	6	10	4	4	61.5
R	10	10.	5.8	10.	10	10	4	4	63.8

Task/Skill Difficulty Analysis for Low Yo-Yo
Task Difficulty Index: 66.04 Skill Value Range: 46.2-73.5

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5	2.5	6.7	10	7	4	4	46.2
B	9	7.5	2.5	10.	10	7	8	4	58.0
C	10	10.	5.8	10.	10	10	6	10	71.8
D	10	10.	6.6	10.	10	10	6	10	72.6
E	10	10.	6.6	10.	10	7	6	10	69.6
F	10	10.	5.0	6.7	10	7	4	4	56.7
G	10	10.	5.8	10.	10	10	6	10	71.8
H	10	10.	6.6	10.	10	10	6	10	72.6
I	10	10.	7.5	10.	10	10	6	4	67.5
J	10	10.	8.3	10.	10	7	6	10	71.1
K	10	10.	5.8	8.3	10	7	4	4	59.1
L	10	10.	5.8	10.	10	10	6	10	71.8
M	10	10.	7.5	10.	10	10	2	2	61.5
N	10	10.	5.8	10.	10	10	6	10	71.8
O	10	10.	7.5	10.	10	10	6	10	73.5
P	10	10.	6.6	10.	10	7	6	8	67.6
Q	10	10.	7.5	10.	10	7	7	4	65.5
R	8	7.5	6.6	10.	10	10	4	4	60.1

Task/Skill Difficulty Analysis for Counter Low Yo-Yo
Task Difficulty Index: 62.09 Skill Value Range: 51.3-73.6

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	8	7.5	3.3	8.3	10	7	5	4	53.1
B	10	10.	5.	6.7	10	7	6	4	58.7
C	10	10.	5.	10.	10	10	7	4	66.0
D	10	10.	5.	3.3	10	7	4	4	53.3
E	10	10.	4.2	3.3	10	7	5	4	53.5
F	10	10.	3.3	8.3	10	7	5	4	57.6
G	10	10.	3.3	10.	10	10	6	10	69.3
H	10	10.	6.6	10.	10	10	7	10	73.6
I	10	10.	6.6	10.	10	7	6	10	69.6
J	10	10.	6.6	8.3	10	7	5	4	60.9
K	10	10.	5.8	8.3	10	7	4	4	59.1
L	10	10.	5.	10.	10	10	7	10	72.0
M	10	10.	6.6	10.	10	10	7	10	73.6
N	10	10.	7.5	10.	10	10	6	10	73.5
O	10	10.	5.8	10.	10	7	2	2	56.8
P	10	10.	6.6	10.	6	7	2	2	53.6
Q	10	10.	6.6	1.7	6	7	6	4	51.3

Task/Skill Difficulty Analysis for High Yo-Yo
Task Difficulty Index: 64.33 Skill Value Range: 46.2-76.0

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5.	2.5	6.7	10	7	4	4	46.2
B	9	7.5	3.3	10.	10	10	10	10	69.8
C	10	10.	10.	10.	10	10	6	10	76.0
D	10	10.	6.6	5.	6	10	6	10	63.6
E	10	10.	6.6	10.	10	10	6	8	70.6
F	10	10.	4.2	10.	10	7	2	2	55.2
G	10	10.	5.	6.7	10	7	4	4	56.7
H	10	10.	5.8	10.	10	10	6	10	71.8
I	10	10.	7.5	10.	10	10	4	4	65.5
J	10	10.	6.6	10.	10	10	4	4	64.6
K	10	10.	6.6	10.	10	10	2	2	60.6
L	10	10.	5.8	10.	10	10	6	8	69.8
M	10	10.	7.5	10.	10	10	6	10	73.5
N	10	10.	8.3	10.	10	10	6	10	74.3
O	10	10.	5.	10.	6	7	4	4	56.0
P	8	7.5	5.	1.7	10	10	6	4	52.2
Q	10	10.	6.6	10.	10	10	6	4	66.6
R	10	10.	6.6	10.	10	10	7	4	67.6
S	10	10.	7.5	3.3	10	10	7	4	61.8

Task/Skill Difficulty Analysis for Counter High Yo-Yo
Task Difficulty Index: 61.06 Skill Value Range: 45.3-73.6

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5.	.8	8.3	10	7	5	4	47.1
B	7	5.	1.6	6.7	10	7	4	4	45.3
C	9	7.5	2.5	5.	10	10	9	10	63.0
D	10	10.	8.3	10.	10	10	8	4	70.3
E	10	10.	5.8	10.	10	7	7	10	69.8
F	10	10.	5.8	10.	10	7	5	4	61.8
G	10	10.	5.	3.3	10	7	5	4	54.3
H	10	10.	6.6	10.	10	10	6	10	72.6
I	10	10.	6.6	10.	10	10	7	10	73.6
J	10	10.	6.6	10.	10	7	7	4	64.6
K	10	10.	6.6	6.7	10	7	4	4	58.3
L	10	10.	5.	3.3	6	7	5	4	50.3
M	10	10.	5.	10.	10	10	7	10	72.0
N	10	10.	8.3	10.	10	10	6	4	68.3
O	10	10.	8.3	10.	10	7	7	10	72.3
P	10	10.	5.8	3.3	6	7	5	4	51.1
Q	10	10.	6.6	10.	10	7	2	2	57.6
R	10	10.	6.6	1.7	6	7	2	4	47.3
S	10	10.	6.6	10.	10	10	2	2	60.6

Task/Skill Difficulty Analysis for Racetrack DART
Task Difficulty Index: 65.61 Skill Value Range: 43.9-76.3

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5.	2.5	8.3	10	7	4	4	47.8
B	7	5.	4.2	6.7	6	7	4	4	43.9
C	9	7.5	4.2	8.3	6	7	4	4	50.0
D	9	7.5	4.2	10.	10	10	10	10	70.7
E	10	10.	8.3	10.	10	10	8	10	76.3
F	10	10.	9.1	10.	10	10	6	4	69.1
G	10	10.	8.3	10.	10	7	6	10	71.3
H	10	10.	8.3	10.	10	7	6	4	65.3
I	9	7.5	4.2	6.7	6	7	4	4	48.4
J	9	7.5	5.	10.	10	10	8	10	69.5
K	10	10.	10.	10.	10	10	4	4	68.0
L	10	10.	6.6	10.	10	10	2	2	60.6
M	10	10.	5.	6.7	10	7	4	4	56.7
N	9	10.	3.3	10.	10	10	8	10	70.3
O	10	10.	9.1	10.	10	10	6	8	73.1
P	10	10.	6.6	6.7	10	10	4	4	61.3
Q	10	10.	5.	10.	10	7	8	10	70.0
R	10	10.	6.6	8.3	10	7	6	4	61.9
S	10	10.	5.8	10.	10	10	8	4	67.8
T	10	10.	6.6	10.	10	10	9	4	69.6
U	10	10.	7.5	10.	10	10	8	4	69.5
V	10	10.	9.1	10.	10	10	7	4	70.1
W	10	10.	7.5	10.	10	10	10	4	71.5
X	10	10.	10.	10.	10	10	6	4	70.0
Y	10	10.	9.1	10.	10	10	6	10	75.1
Z	10	10.	8.3	10.	10	10	8	4	70.3
AA	10	10.	7.5	10.	10	10	6	10	73.5

AD-A061 478 DESIGN PLUS ST LOUIS MO F/G 5/9
DEVELOPMENT AND APPLICATION OF A TASK TAXONOMY FOR TACTICAL FLY--ETC(U)
SEP 78 R P MEYER, J I LAVESON, G L PAPE F33615-77-C-0020
UNCLASSIFIED AFHRL-TR-78-42(III) NL

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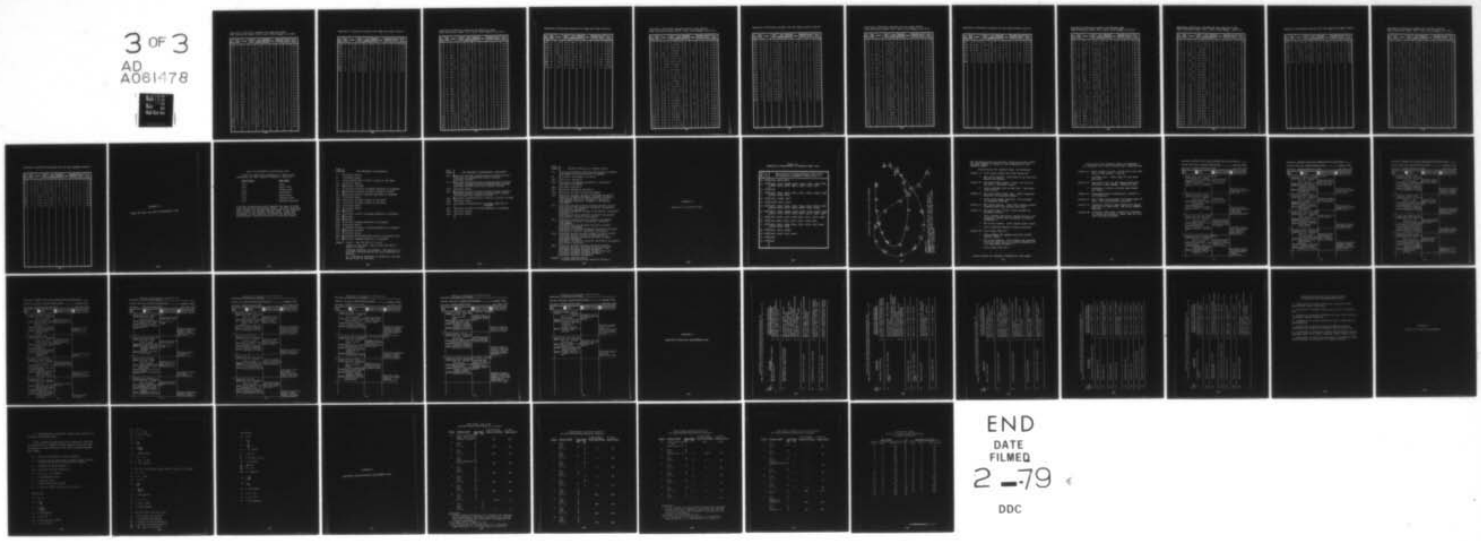

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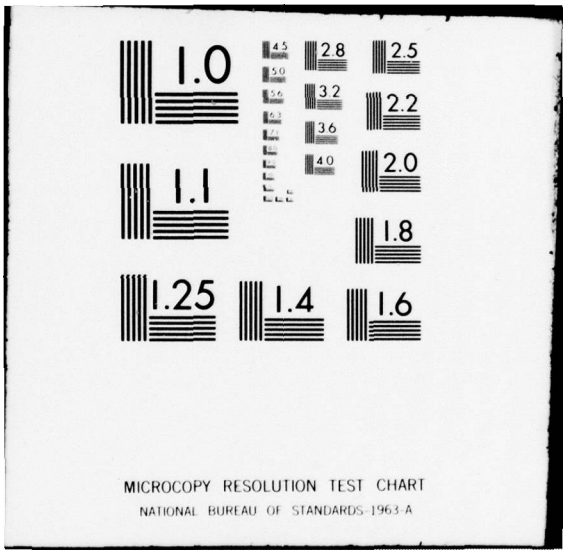
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Task/Skill Difficulty Analysis for High Dive Bomb
Task Difficulty Index: 60.08 Skill Value Range: 47.0-78.0

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5.	5.	8.3	10	7	4	4	50.3
B	9	7.5	6.6	10.	10	7	4	4	58.1
C	9	7.5	4.2	8.3	10	7	4	4	54.0
D	9	7.5	4.2	10.	10	10	8	10	68.7
E	10	10.	10.	10.	10	10	8	10	78.0
F	10	10.	7.5	10.	10	7	6	10	70.5
G	8	7.5	5.	1.7	10	7	4	4	47.2
H	8	7.5	5.8	6.7	10	7	4	4	53.0
I	8	7.5	5.8	10.	10	10	6	10	67.3
J	8	7.5	6.6	10.	10	10	8	10	70.1
K	10	10.	8.3	10.	10	7	6	8	69.3
L	8	7.5	8.3	10.	10	7	4	4	58.8
M	9	7.5	5.8	10.	10	7	2	2	53.3
N	8	7.5	5.	10.	6	7	4	4	51.5
O	7	5.	2.5	8.3	10	7	4	4	47.8
P	7	5.	3.3	6.7	10	7	4	4	47.0
Q	7	5.	3.3	10.	6	10	10	10	61.3
R	10	10.	9.1	10.	10	10	6	8	73.1
S	10	10.	5.8	10.	10	6	6	10	67.8
T	8	7.5	3.3	10.	10	10	6	4	58.8
U	10	10.	7.5	1.7	10	10	4	4	57.2
V	10	10.	6.6	8.3	10	10	4	4	62.9
W	10	10.	5.8	6.7	10	7	4	4	57.5
X	10	10.	6.6	10.	10	10	7	10	73.6
Y	10	10.	7.5	10.	10	10	8	10	75.5
Z	10	10.	9.1	10.	10	7	6	4	66.1
AA	10	10.	6.6	10.	10	7	4	4	61.6
BB	9	7.5	3.3	6.7	10	7	4	4	51.5
CC	9	7.5	4.2	10.	10	7	6	4	57.7
DD	9	7.5	5.	10.	10	7	6	4	58.5

Task/Skill Difficulty Analysis for High Dive Bomb (cont'd)

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
EE	7	7.5	5.	10.	10	7	7	4	57.5
FF	9	7.5	5.	10.	6	10	2	2	51.5
GG	10	10.	5.	10.	10	10	4	4	63.0
HH	10	10.	5.	10.	6	7	2	2	52.0
II	10	10.	4.2	10.	6	7	4	4	55.2
JJ	8	7.5	5.	6.7	10	7	4	4	52.2
KK	7	5.	4.2	10.	10	10	6	10	62.2
LL	8	7.5	5.8	10.	10	7	6	10	64.3
MM	8	7.5	5.8	10.	10	7	6	10	64.3
NN	8	7.5	5.8	10.	6	7	4	4	52.3

Task/Skill Difficulty Analysis for High Dive Toss
Task Difficulty Index: 61.1 Skill Value Range: 44.2-76.3

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5.	3.3	8.3	10	7	4	4	48.6
B	7	5.	5.	8.3	10	7	4	4	50.3
C	7	5.	3.3	6.7	10	7	4	4	47.0
D	7	5.	3.3	10.	10	10	6	10	61.3
E	10	10.	8.3	10.	10	10	8	10	76.3
F	10	10.	8.3	10.	10	7	6	10	71.3
G	8	7.5	5.	8.3	6	7	6	4	51.8
H	10	10.	7.5	6.7	10	7	4	4	59.2
I	8	7.5	5.8	10.	10	10	6	10	67.3
J	8	7.5	6.6	10.	10	10	8	10	70.1
K	10	10.	8.3	10.	10	7	6	4	65.3
L	8	7.5	4.2	10.	10	10	4	4	57.7
M	10	10.	6.6	10.	10	7	2	2	57.6
N	8	7.5	5.	10.	10	7	4	4	55.5
O	7	5.	1.6	6.7	10	7	4	4	45.3
P	7	5.	2.5	10.	10	10	10	10	64.5
Q	10	10.	9.1	10.	10	10	6	8	73.1
R	10	10.	6.6	10.	10	10	6	10	72.6
S	10	10.	5.8	10.	10	10	6	10	71.8
T	7	7.5	3.3	1.7	10	7	4	4	44.5
U	10	10.	6.6	6.7	10	7	4	4	58.3
V	10	10.	5.	10.	10	10	6	10	71.0
W	10	10.	5.8	10.	10	10	8	10	73.8
X	10	10.	7.5	10.	6	7	7	4	61.5
Y	10	10.	6.6	10.	10	7	6	4	63.6
Z	9	3.5	4.2	6.7	10	7	4	4	48.4
AA	9	7.5	5.	1.7	6	7	4	4	44.2
BB	9	7.5	4.2	10.	10	7	8	4	59.7
CC	9	7.5	5.	10.	6	7	6	4	54.5
DD	9	7.5	5.	10.	10	7	6	4	58.5
EE	9	7.5	4.2	6.7	10	7	6	4	54.4

Task/Skill Difficulty Analysis for High Dive Toss (cont'd)

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
FF	9	7.5	4.2	10.	10	10	3	4	57.7
GG	10	10.	6.6	10.	10	10	3	4	63.6
HH	10	10.	7.5	10.	6	10	3	4	60.5
II	10	10.	4.2	10.	10	10	2	2	58.2
JJ	10	10.	4.2	10.	10	10	4	4	62.2
KK	8	7.5	4.2	6.7	10	7	4	4	51.4
LL	8	7.5	5.8	10.	10	10	8	10	69.3
MM	8	7.5	6.6	10.	10	10	6	10	68.1
NN	8	7.5	6.6	10.	10	7	6	10	65.1
OO	10	10.	5.	10.	6	7	4	4	56.0

Task/Skill Difficulty Analysis for Low Angle Pop-Up
Task Difficulty Index: 58.97 Skill Value Range: 41.5-74.6

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5.	5.	8.3	6	7	4	4	46.3
B	7	5.	2.5	10.	10	7	4	4	49.5
C	9	7.5	2.5	6.7	10	7	4	4	50.7
D	7	5.	1.6	10.	10	10	8	10	61.6
E	10	10.	6.6	10.	10	10	8	10	74.6
F	10	10.	5.8	10.	10	7	6	10	68.8
G	8	7.5	3.3	1.7	6	7	4	4	41.5
H	8	7.5	4.2	6.7	10	7	4	4	51.4
I	7	7.5	4.2	10.	10	10	6	10	64.7
J	8	7.5	5.	10.	10	10	6	10	66.5
K	10	10.	5.8	10.	10	7	6	4	62.8
L	8	7.5	5.	10.	10	7	4	4	55.5
M	7	5.	1.6	8.3	10	7	4	4	46.9
N	7	5.	1.6	6.7	10	7	4	4	45.3
O	7	5.	1.6	10.	10	10	6	8	57.6
P	8	7.5	5.	10.	10	10	8	10	68.5
Q	10	10.	7.5	10.	6	7	6	10	66.5
R	8	7.5	4.2	1.7	10	7	4	4	46.4
S	10	10.	5.8	6.7	10	7	4	4	57.5
T	10	10.	5.8	5.	6	10	6	10	62.8
U	10	10.	5.	10.	10	10	6	10	71.0
V	10	10.	5.8	10.	6	7	6	4	58.8
W	10	10.	3.3	10.	10	10	8	10	71.3
X	10	10.	5.8.	10.	10	7	8	4	64.8
Y	10	10.	5.8	1.7	6	7	4	4	48.5
Z	10	10.	4.2	1.7	10	7	4	4	50.9
AA	10	10.	4.2	10.	10	10	4	4	62.2
BB	10	10.	5.8	10.	10	10	2	2	59.8
CC	10	10.	3.3	10.	6	7	2	2	50.3
DD	10	10.	5.	3.3	6	7	4	4	49.3
EE	10	10.	3.3	3.3	6	7	4	4	47.6

Task/Skill Difficulty Analysis for Low Angle Pop-Up (cont'd)

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
FF	10	10.	4.2	6.7	10	7	4	4	55.9
GG	10	10.	5.	10.	10	10	8	10	73.0
HH	10	10.	7.5	10.	10	10	6	10	73.5
II	10	10.	5.8	10.	10	10	6	4	65.8
JJ	10	10.	7.5	10.	10	7	6	4	64.5
KK	10	10.	5.8	10.	10	10	2	2	59.8
LL	10	10.	3.3	10.	10	10	6	10	69.3
MM	10	10.	6.6	10.	10	10	6	4	66.6
NN	10	10.	6.6	10.	6	7	6	4	59.6
OO	10	10.	5.8	10.	10	7	6	4	62.8
PP	9	7.5	4.2	6.7	10	7	4	4	52.4
QQ	9	7.5	3.3	10.	10	7	6	4	56.8
RR	9	7.5	3.3	10.	10	7	8	4	58.8
SS	9	7.5	5.	8.3	10	7	7	4	57.8
TT	9	7.5	4.2	10.	10	10	2	2	54.7
UU	10	10.	4.2	10.	10	10	4	4	62.2
VV	10	10.	5.	10.	10	7	2	2	56.0
WW	8	7.5	3.3	6.7	10	7	4	4	50.5
XX	8	7.5	5.8	10.	10	10	6	10	67.3
YY	8	7.5	5.8	10.	10	10	6	10	67.3
ZZ	8	7.5	5.8	10.	6	7	6	10	60.3
AAA	8	7.5	4.2	10.	6	7	4	4	50.7

Task/Skill Difficulty Analysis for Low Angle Strafe
Task Difficulty Index: 59.8 Skill Value Range: 43.0-72.6

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5.	5.	8.3	10	7	4	4	50.3
B	7	5.	5.8	10.	10	7	4	4	52.8
C	7	5.	3.3	6.7	6	7	4	4	43.0
D	7	5.	3.3	10.	10	10	6	8	59.3
E	8	7.5	6.6	10.	10	10	8	10	70.1
F	10	10.	9.1	10.	10	7	6	10	72.1
G	8	7.5	5.	8.3	10	7	6	4	55.8
H	10	10.	7.5	6.7	10	7	4	4	59.2
I	8	7.5	5.8	10.	10	10	6	10	67.3
J	8	7.5	6.6	10.	10	10	8	10	70.1
K	10	10.	9.1	10.	6	7	6	4	62.1
L	8	7.5	4.2	10.	6	10	4	4	53.7
M	10	10.	6.6	10.	6	7	2	2	53.6
N	8	7.5	5.	10.	6	7	4	4	51.5
O	7	5.	2.5	8.3	10	7	6	4	49.8
P	9	7.5	5.	6.7	10	7	4	4	53.2
Q	7	5.	2.5	10.	10	10	8	10	62.5
R	10	10.	5.8	10.	10	10	6	10	71.8
S	10	10.	5.8	10.	10	7	6	10	68.8
T	10	10.	4.2	1.7	6	7	4	4	46.9
U	10	10.	4.2	6.7	10	7	4	4	55.9
V	10	10.	5.8	10.	10	10	6	10	71.8
W	10	10.	6.6	10.	10	10	6	10	72.6
X	10	10.	6.6	10.	10	7	6	4	63.6
Y	10	10.	7.5	10.	10	7	4	4	62.5
Z	9	10.	4.2	6.7	10	7	6	4	56.9
AA	9	7.5	5.	10.	10	10	6	4	61.5
BB	9	7.5	5.	10.	10	7	4	4	56.5
CC	9	7.5	5.8	8.3	10	7	7	4	58.6
DD	9	7.5	7.5	8.3	10	7	7	4	60.3
EE	9	7.5	7.5	8.3	10	7	7	4	60.3

Task/Skill Difficulty Analysis for Low Angle Strafe (cont'd)

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
FF	9	7.5	5.	10.	6	10	2	2	51.5
GG	10	10.	4.2	10.	10	10	4	4	62.2
HH	10	10.	5.	10.	10	10	2	2	59.0
II	10	10.	4.2	6.7	10	7	4	4	55.9
JJ	8	7.5	5.8	10.	10	10	6	10	67.3
KK	8	7.5	5.8	10.	10	10	6	10	67.3
LL	8	7.5	6.6	10.	10	7	6	10	65.1
MM	8	7.5	4.2	10.	6	7	4	4	50.7

Task/Skill Difficulty Analysis for Nuclear LADD
Task Difficulty Index: 56.4 Skill Value Range: 39.9-74.6

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5.	1.6	3.3	6	7	6	4	39.9
B	9	7.5	3.3	6.7	6	7	4	4	47.5
C	9	7.5	5.	5.	6	10	4	4	50.5
D	10	10.	4.2	10.	10	10	2	2	58.2
E	8	7.5	3.3	10.	10	7	2	2	49.8
F	10	10.	3.3	10.	6	7	4	4	54.3
G	7	5.	.8	6.7	10	7	4	4	44.5
H	7	5.	2.5	10.	10	10	4	4	52.5
I	10	10.	5.8	10.	10	10	2	2	59.8
J	10	10.	5.	10.	10	10	2	2	59.0
K	10	10.	6.6	10.	10	7	5	4	62.6
L	7	5.	4.2	6.7	10	7	4	4	47.9
M	7	5.	4.2	10.	10	10	8	10	64.2
N	10	10.	6.6	10.	10	10	8	10	74.6
O	10	10.	6.6	10.	10	10	6	8	70.6
P	8	7.5	5.	10.	10	10	6	10	66.5
Q	8	7.5	4.2	10.	10	10	6	10	65.7
R	8	7.5	6.6	10.	6	7	6	4	55.1
S	7	5.	.1	8.3	10	7	4	4	45.4
T	7	5.	3.3	3.3	6	7	5	4	40.6
U	9	7.5	4.2	10.	10	10	4	4	68.7
V	9	7.5	5.	10.	10	7	4	4	56.5
W	9	7.5	3.3	6.7	10	7	4	4	51.5
X	9	7.5	2.5	3.3	6	7	5	4	44.3
Y	9	7.5	4.2	5.	6	7	5	10	53.7
Z	10	10.	5.8	10.	10	10	3	4	62.8
AA	10	10.	5.8	3.3	6	7	5	4	51.1
BB	10	10.	5.	10.	10	10	8	10	73.0
CC	10	10.	8.3	10.	10	10	6	10	74.3
DD	8	7.5	5.8	10.	10	7	6	10	64.3
EE	10	10.	4.2	3.3	6	7	4	4	48.5

Task/Skill Difficulty Analysis for Low Angle Dive Bomb
Task Difficulty Index: 61.1 Skill Value Range: 46.9-75.5

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5.	3.3	8.3	10	7	4	4	48.6
B	7	5.	5.	8.3	10	7	4	4	50.3
C	7	5.	3.3	6.7	10	7	4	4	47.0
D	9	7.5	.4	10.	10	10	6	10	62.9
E	10	10.	7.5	10.	10	10	8	10	75.5
F	10	10.	8.3	10.	10	7	6	10	71.3
G	8	7.5	5.8	8.3	6	7	6	4	52.6
H	10	10.	7.5	6.7	10	7	4	4	59.2
I	8	7.5	5.8	10.	10	10	6	8	65.3
J	8	7.5	6.6	10.	10	10	8	10	70.1
K	10	10.	8.3	10.	6	7	6	4	61.3
L	8	7.5	5.8	10.	10	10	4	4	59.3
M	10	10.	6.6	10.	10	7	2	2	57.6
N	8	7.5	5.8	10.	10	7	6	4	58.3
O	9	7.5	3.3	6.7	6	7	4	4	47.5
P	7	5.	2.5	10.	10	10	8	10	62.5
Q	10	10.	5.8	10.	10	10	6	10	71.8
R	10	10.	5.8	10.	10	7	6	10	68.8
S	10	10.	4.2	1.7	6	7	4	4	46.9
T	10	10.	5.8	6.7	10	7	4	4	57.5
U	10	10.	5.8	10.	10	10	6	10	71.8
V	10	10.	6.6	10.	10	10	8	10	74.6
W	10	10.	7.5	10.	10	7	6	4	64.5
X	10	10.	8.3	10.	10	7	4	4	63.3
Y	10	10.	5.8	6.7	6	7	4	4	53.5
Z	10	10.	6.6	10.	10	10	6	4	66.6
AA	10	10.	5.8	10.	10	10	6	4	65.8
BB	10	10.	8.3	10.	10	7	6	4	65.3
CC	10	10.	5.8	8.3	10	7	6	4	61.1
DD	10	10.	5.	8.3	10	7	6	4	60.3
EE	10	10.	5.	8.3	10	7	7	4	61.3

Task/Skill Difficulty Analysis for Low Angle Dive Bomb (cont'd)

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
FF	8	7.5	5.	10.	6	10	4	4	54.5
GG	10	10.	5.8	10.	10	10	4	4	63.8
HH	10	10.	4.2	10.	6	7	2	2	51.2
II	8	7.5	5.	6.7	6	7	6	4	50.2
JJ	8	7.5	5.	10.	10	10	8	10	68.5
KK	8	7.5	6.6	10.	10	10	6	10	68.1
LL	8	7.5	6.6	10.	10	7	6	10	65.1
MM	10	10.	5.	10.	10	7	4	4	60.0

Task/Skill Difficulty Analysis for 30° Dive Rockets
Task Difficulty Index: 59.77 Skill Value Range: 43.2-76.3

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
A	7	5.	5.	8.3	10	7	4	4	50.3
B	9	7.5	5.8	8.3	10	7	4	4	55.6
C	9	7.5	4.2	6.7	10	7	4	4	52.4
D	7	5.	3.3	10.	10	10	8	10	63.3
E	10	10.	8.3	10.	10	10	8	10	76.3
F	10	10.	7.5	10.	10	7	6	10	70.5
G	8	7.5	5.	1.7	6	7	4	4	43.2
H	8	7.5	5.8	6.7	10	7	4	4	53.0
I	8	7.5	6.6	10.	10	10	6	10	68.1
J	8	7.5	6.6	10.	10	10	8	10	70.1
K	10	10.	8.3	10.	6	7	6	4	61.3
L	8	7.5	5.8	10.	6	7	4	4	52.3
M	7	5.	3.3	10.	10	7	4	4	50.3
N	8	7.5	4.2	10.	10	7	4	4	54.7
O	7	5.	2.5	8.3	10	7	4	4	47.8
P	7	5.	4.2	6.7	10	7	4	4	47.9
Q	7	5.	4.2	10.	10	10	8	10	64.2
R	10	10.	8.3	10.	10	10	6	8	72.3
S	10	10.	6.6	10.	6	7	6	10	65.6
T	8	7.5	4.2	10.	10	10	8	4	61.7
U	10	10.	6.6	8.3	10	10	6	4	64.9
V	10	10.	7.5	8.3	10	10	4	4	63.8
W	10	10.	5.	6.7	10	10	4	4	59.7
X	10	10.	6.6	10.	10	10	6	8	70.6
Y	10	10.	6.6	10.	10	10	6	8	70.6
Z	10	10.	9.1	10.	10	7	6	4	66.1
AA	10	10.	9.1	10.	10	7	4	4	64.1
BB	9	7.5	5.	10.	10	7	6	4	58.5
CC	9	7.5	5.	6.7	10	7	4	4	53.2
DD	9	7.5	4.2	10.	10	7	6	4	57.7
EE	9	7.5	5.	10.	10	7	6	4	58.5

Task/Skill Difficulty Analysis for 30° Dive Rockets (cont'd)

EL. SEQ.	CUES KIND	QUAN.	INPUT INDEX	INFO. PROCESS	DECISION PROCESS	CONT.	CONTROL OUTPUT	OUTPUT INDEX	SKILL VALUE
FF	9	7.5	5.	10.	10	7	7	4	59.5
GG	9	7.5	5.8	10.	10	10	2	2	56.3
HH	10	10.	5.8	10.	10	10	4	4	63.8
II	10	10.	6.6	10.	6	10	2	2	56.6
JJ	10	10.	4.2	10.	6	7	4	4	55.2
KK	8	7.5	3.3	6.7	6	7	4	4	46.5
LL	8	7.5	5.	10.	10	10	6	10	66.5
MM	8	7.5	5.8	10.	10	10	6	8	65.3
NN	8	7.5	5.8	10.	6	7	6	10	60.3
OO	8	7.5	5.8	10.	6	7	4	4	52.3

APPENDIX F

BASIC UPT TASK AND SKILL DISTRIBUTION DATA

Basic UPT Task/Skill Distribution Data

Seven UPT tasks were considered to contain some commonality to basic fighter maneuvers. They are:

Task Number	Task Name
Ct-1	Loop
Ct-2	Barrel Roll
Ct-3	Aileron Roll
Ct-4	Cloverleaf
Ct-5	Cuban-Eight
Ct-6	Immelman Turn
Ct-7	Vertical Recovery

A surface analysis had been completed for each of these tasks during the UPT taxonomy study. The skill data were thus available in useable form and added to the classification matrix for tactical flying tasks. Using this technique, it was possible to compare UPT skills with representative tactical skills on a one-to-one basis.

Slot Number	UPT Task/Skill Distribution
1.	Ct-3(A) (solo)
2.	Ct-2(N) (solo)
7.	Ct-1(O)/Ct-7(O) Ct-3(I)/ (alone in the slot)
11.	Ct-1(C) (solo)
17. ▷	Ct-5(V), Ct-2(M)
31.	/Ct-5(C) Ct-4(C)/ (nothing identical or kindred)
36. ▷	/Ct-6(G) Ct-4(L)/ Ct-3(B), Ct-4(M), Ct-6(C)
37. ▷	Ct-5(L) Ct-4(J) (nothing identical or kindred)
122.	Ct-5(W) (solo)
182.	Ct-5(A), Ct-7(A) (alone in the slot)
183.	Ct-1(A), Ct-4(A) (alone in the slot)
185.	Ct-2(A) (solo)
187.	Ct-4(N) (solo)
196. ▷	Ct-1(I)
252.	Ct-3(H), Ct-6(O) (nothing identical or kindred)
256. ▷	Ct-1(G)
259. ▷	Ct-7(N)
260.	Ct-1(N) (nothing identical or kindred)
266.	Ct-1(E) (solo)
271.	/Ct-5(D) Ct-7(D)/ (nothing identical or kindred)
272. ▷	Ct-4(D), Ct-6(N)
273.	Ct-3(E) (solo)
274. ▷	/Ct-3(D) Ct-3(F)/Ct-2(B) Ct-2(C) Ct-2(F)/Ct-3(G)
275. ▷	Ct-2(D) (nothing identical or kindred)

Legend: (solo) - One UPT skill in a slot

(alone in the slot) - Two or more UPT skills alone in a slot.

(nothing identical or kindred) - UPT skills in a slot with tactical skills but none identical or kindred.

▷ - UPT skills identical or kindred to tactical skills found in the slot.

Slot Number	UPT Task/Skill Distribution (concluded)
276.	/Ct-7(C) Ct-7(E) Ct-5(G) Ct-5(O) Ct-6(H) Ct-1(H) Ct-6(E) Ct-1(M)/Ct-5(F) Ct-1(J) Ct-6(I)/ Ct-5(N), Ct-1(L)
277.	/Ct-4(B) Ct-6(B) Ct-5(B) Ct-7(B)/Ct-6(F) Ct-5(E)/ Ct-2(J) Ct-6(M)/Ct-7(I) Ct-2(H)/Ct-4(E) Ct-5(M)/ Ct-1(B), Ct-4(C), Ct-7(F), Ct-5(U), Ct-1(F)
278.	Ct-5(K) (solo)
279.	/Ct-2(K) Ct-2(L) Ct-2(G) Ct-4(H) Ct-6(L) Ct-6(K) Ct-5(R) Ct-5(S) Ct-5(J) Ct-7(G)/Ct-1(K) Ct-5(Q) Ct-5(I)/Ct-7(L), Ct-4(G), Ct-5(T)
280.	/Ct-2(I) Ct-4(I)/Ct-6(J), Ct-7(J), Ct-7(H), Ct-7(M)
354.	Ct-2(E) (solo)
356.	/Ct-6(D) Ct-5(H)/Ct-5(P) (nothing identical or kindred)
357.	Ct-3(C), Ct-4(F) (nothing identical or kindred)
396.	Ct-7(K) (solo)
422.	Ct-6(A) (solo)

Slot Number	UPT/TAC Identical or Kindred Skills
17.	/Ct-5(V) CR-1g(II) CR-7g(JJ)/Cr-2g(OO)* CR-5g(F)* CR-6g(MM)* CR-7a(O)*/Ct-2(M) CR-1g(MM)/
37.	Ct-5(L)*, CR-1a(EE)*, CR-3a(H)*
196.	Ct-1(I)*, CR-1a(J)*
256.	Ct-1(G)*, CR-1g(M)*, CR-3g(VV)*, CR-6g(HH)*, CR-7g(M)*, CR-7a(F)*
259.	Ct-7(N)* CR-5a(P)*
272.	Ct-4(D)* CR-2g(L)* CR-5g(U)*
274.	/Ct-2(B) Ct-2(F) Ct-2(C) CR-7g(MM)/
275.	/Ct-2(D) CR-1g(I) CR-2g(I) CR-3g(XX) CR-3g(YY) CR-4(I) CR-4g(JJ) CR-4(KK) CR-6g(I)/ CR-1a(A)*, CR-1a(CC)*, CR-3(J)*, CR-5g(P)*, CR-7(LL)*, CR-2g(MM)*, CR-3g(I)*, CR-5g(I)*, CR-6g(KK)*, CR-7g(I)*
276.	/Ct-1(M) Ct-1(H) Ct-5(G) Ct-5(O) Ct-6(E) Ct-6(H) Ct-7(C) Ct-7(E) CR-2g(II) CR-5g(D)/ CR-3g(BB)*, CR-3g(KK)*, CR-5g(I)* /Ct-5(N) CR-4g(HH) CR-5g(J)/ CR-3g(BB)*, CR-3g(KK)* CR-5g(I)* /Ct-1(L) CR-7a(K) CR-8a(S) CR-9a(K)/ CR-3g(BB)* CR-3g(KK)*, CR-5a(I)*, CR-5a(M)*
277.	/Ct-2(J) Ct-6(M) CR-1a(Z) CR-3a(K) CR-3g(II)/ CR-1a(D)*, CR-3a(L)*, CR-3a(M)*, CR-7a(O)*, CR-3g(MM)* /Ct-2(H) Ct-7(I) CR-1a(D) CR-3a(L) CR-3a(M) CR-7a(Q) CR-3g(MM)/ CR-1a(Z)*, CR-3a(G)* CR-3a(K)* CR-5a(I)* CR-8a(N)* CR-3g(II)* Ct-5(O)* CR-6g(GG)* CR-7g(HH)*
279.	/Ct-2(C) Ct-2(G) Ct-2(K) Ct-4(H) Ct-5(J) Ct-5(R) Ct-5(S) Ct-6(L) Ct-6(K) Ct-7(G) CR-7a(L)/ /Ct-5(T) CR-2a(I) CR-2a(K) CR-7a(E) CR-1g(X) CR-7g(X) CR-7g(Y)/ Ct-4(G)*, CR-2a(I)*, CR-2(K)*, CR-7a(E)*, CR-1g(X)*, CR-7a(X)*, CR-7a(Y)*
280.	/Ct-2(I) Ct-4(I) CR-2a(U) CR-3a(J) CR-5a(C) CR-5a(G) CR-5a(L) CR-5a(N) CR-7a(H) CR-2g(S) CR-4g(R) CR-4g(Y) CR-6g(Q) CR-6g(Y)/ /Ct-7(J) CR-2a(M) CR-4a(G) CR-5a(D) CR-5a(H) CR-8a(H) CR-4g(G) CR-4g(W) CR-5g(O)/ /Ct-6(J) CR-6a(G) CR-3g(LL)/

Legend: * shows kindred skills.
(Unasterisked skills are identical skills.)

APPENDIX G

STANDARD TASK ANALYSIS DATA

Table G-1.
Task/Skill Distribution of Standard Task, St-2

Skill / Slot	Skills with in the Representative Tasks which are Identical or Kindred to Skills of St - 2
A - 292	6a(A), 6g(G),2g(G)
B - 337	3g(Z), 4a(O), 3g(FF) 4g(II), 6a(B), 1a(X), 3a(E) 5a(K) 1g(W), 3g(S), 6g(T), 4g(V), 9a(M), 5a(F), 7a(G)
C - 275	9a(C)
D - 280	7a(N), 7a(C), 9a(Y), 5a(O), 6a(N), 7a(M), 9a(AA), 5a(H) 8a(H), 2a(M), 4a(G)
E - 277	7a(J), 1a(DD), 7a(I)
F - 277	1a(DD), 7a(J), 7a(I)
G - 280	2a(U), 3a(J), 5a(C), 5a(G), 5a(L), 5a(N), 7a(H), 5a(H) 8a(H), 5a(D), 2a(M), 5a(O), 6a(N), 7a(M), 9a(AA)
H - 280	5a(O), 7a(M), 9a(AA), 5a(H), 8a(H), 5a(D), 2a(M), 5a(O) 6a(N), 7a(M), 5a(H), 7a(N), 2a(U), 3a(J), 5a(K), 5a(G)
I - 280	5a(H), 8a(H), 5a(D), 2a(M) 2a(U), 3a(J), 5a(C), 5a(K)
K - 280	5a(D) 2a(M), 7a(N), 5a(C), 9a(Y), 2a(N) 4a(G)
L - 277	1a(D), 3a(L), 3a(M) 7a(Q), 2a(F), 2a(G), 5a(I) 1a(Z) 3a(K), 3a(G), 7a(R)
M - 277	7a(I), 7a(J), 1a(DD)
N - 276	5a(M), 7a(K), 8a(S), 9a(L)
O - 277	7a(J)
P - 277	None

Standard Tasks, St-1 and St-2 Task Diagram

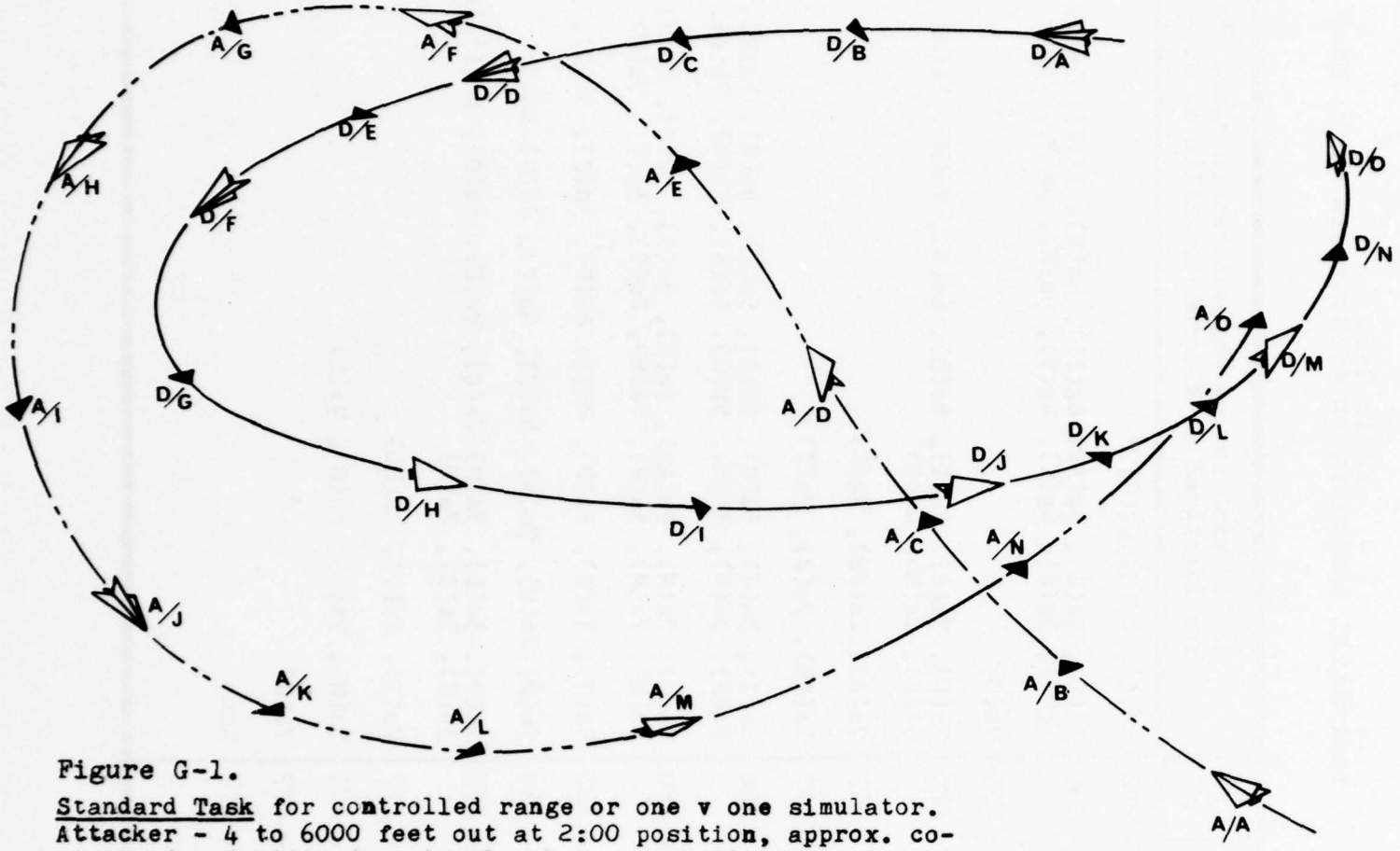

Figure G-1.

Standard Task for controlled range or one v one simulator. Attacker - 4 to 6000 feet out at 2:00 position, approx. co-airspeed and altitude, missile shot, converting to a tracking gun shot - like aircraft.

The following action points were listed and placed within the task diagram to assist in the preparation of the standard tasks:

Action Points for Standard Task, St-1/Attacker

A/Skill A: Pilot spots target and calls "Tally-Ho."

* WSO calls lock-on. Pilot goes to AB (and hits Master Arm switch).

A/Skill B: WSO gives "aero calls." Pilot into pull-up and roll to maintain visual.

* Pilot continues pull up and roll. WSO gives "aero calls."

A/Skill F: WSO calls radar broke lock. Pilot continues maneuver and maintains visual.

* Pilot calls target position. WSO attempts to reacquire lock-on.

A/Skill I: WSO calls lock-on. Pilot hits "pinkie switch" (missile heat) and defines lead point.

A/Skill J: WSO gives "aero calls." Pilot unloads for maximum overtake.

* Pilot refines lead point, starts pull-up, and continues closure and conversion to missile parameters.

* WSO calls closure. Pilot checks aspect angle.

* Pilot continues missile tracking solution.

A/Skill M: Pilot fires "Fox II."

* Pilot presses for gunshot and hits "pinkie switch" (guns).

* WSO calls closure. Pilot begins gun tracking (could do small Yo-Yo to prevent overshoot or do a snap shot and split).

* Pilot fires "Fox III."

(Action Points for Defender continued on next page.)

Action Points for Standard Task, St-2/Defender
In a Moderate (60°) Turn, Cruise Power, Checking Area

D/Skill A: Spots target at 10:00. Pilot pulls into hard turn to face threat. Hits AB.

* Continues pull. Feels high "G" and hears AOA tone.

D/Skill C: Sees threat pull up and reduces stabilator pressure to gain energy. Maintains turn.

* Continues to unload as threat goes higher and rolls.

D/Skill F: Determines threat attempting to convert to 6:00 position.

D/Skill H: Sees threat pulling down, and begins high "G" turn. WSO calls threat's position.

D/Skill L: Determines threat's high closure and begins hard pull in level turn. WSO calls threat's position.

D/Skill M: Continues tight turn, looking for overshoot to convert to Reversal. Hears "Fox II" call (for training purposes).

SITUATION Defender in 60° turn, checking area at cruise power.

TASK NO. St-2 TASK Standard Training Task AIRCRAFT F-4E

TASK GOAL Perform Defender Roll Task DATE Feb., 1978

EL. SEQ.	1 CUES	2 MENTAL ACTION	3 MOTOR ACTION
A.	ESTABLISHED IN AREA AT CRUISE POWER Visual-Pitch att: constant Bank att: constant Aural-Normal aircraft sound Control-Aileron and stabilator pressure Motion-Positive G, rolling	Determines need for vigilance, Sustains turn	Maintains aileron & stabilator pressure, checks 360°
B.	PREPARES DEFENSIVE ACTION Visual-Pitch att: constant Bank att: constant Threat aircraft Aural-Normal aircraft sound, communication - WSO (calls target) Control-Aileron and stabilator pressure Motion-Positive G, rolling	Anticipates evasive action Sustains turn	Maintains aileron & stabilator pressure, checks threat, communicates (acknowledges target)
C.	STARTS HARD TURN INTO THREAT Visual-Pitch att: constant Bank att: constant Threat aircraft Aural-Normal aircraft sound, communication Control-Aileron and stabilator pressure Motion-Positive G, rolling	Determines threat aircraft maneuvering & need to pull into threat, need to light AB	Coordinates aileron and rudder pressure, moves stabilator, moves throttle, checks threat
D.	CONTINUES TURN INTO THREAT AIRCRAFT Visual-Pitch att: increasing Bank att: rolling Threat aircraft Aural-Chg. in aircraft sound, AOA tone Control-Aileron, rudder and stabilator pressure; throttle movement Motion-Increasing positive G, pitching, rolling, vibration	Determines need to relax stabilator pressure & continue turning into threat aircraft	Coordinates aileron and rudder pressure, relaxes stabilator pressure, checks threat

SITUATION Defender in 60° turn, checking area at cruise power.

TASK NO. St-2 TASK Standard Training Task AIRCRAFT F-4E

TASK GOAL Perform Defender Roll Task DATE Feb., 1978

EL. SEQ.	1 CUES	2 MENTAL ACTION	3 MOTOR ACTION
E.	CONTINUES TO UNLOAD AS THREAT GOES HIGH Visual-Pitch att: decreasing Bank att: rolling Threat aircraft Aural-Chg. in aircraft sound Control-Aileron & rudder pressure, decreased stabilator pressure Motion-Decreasing positive G, pitching down, rolling, acceleration	Determines need to continue to unload & gain energy as threat goes high	Maintains aileron & stabilator pressure, checks threat
F.	CONTINUES DEFENSIVE TURN Visual-Pitch att: decreasing Bank att: constant Threat aircraft Aural-Chg. in aircraft sound Control-Aileron and stabilator pressure Motion-Unloaded G, pitching down, rolling, acceleration	Determines threat starting to convert to 6:00 position	Maintains aileron & stabilator pressure, checks threat
G.	STARTS HIGH G TURN INTO THREAT Visual-Pitch att: decreasing Bank att: constant Threat aircraft Aural-Chg. in aircraft sound Control-Aileron and stabilator pressure Motion-Unloaded G, pitching down, rolling, acceleration	Determines need to counter threat	Coordinates aileron and rudder pressure, moves stabilator
H.	CONTINUES HIGH G CLIMBING TURN Visual-Pitch att: increasing Bank att: rolling Threat aircraft Flt.Inst: cross-check Aural-Chg. in aircraft sound communication - WSO *(calls threat's position) Control-Aileron, rudder and stabilator pressure Motion-Positive G onset, pitching up, rolling	Determines threat maneuvering and need to start a high G climbing turn into threat	Maintains coordinated aileron and rudder pressure, maintains stabilator pressure, checks threat

SITUATION Defender in 60° turn, checking area at cruise power.

TASK NO. St-2 TASK Standard Training Task AIRCRAFT F-4E

TASK GOAL Perform Defender Roll Task DATE Feb., 1978

EL. SEQ.	1 CUES	2 MENTAL ACTION	3 MOTOR ACTION
I.	CONTINUES CLIMBING TURN Visual-Pitch att: increasing Bank att: rolling Threat aircraft Aural-Chg. in aircraft sound *communication - WSO Control-Aileron, rudder and stabilator pressure Motion-Increasing positive G, pitching up, rolling	Determines need to continue climbing turn into threat	Maintains coordinated aileron and rudder pressure, maintains stabilator pressure
J.	CONTINUES CLIMBING TURN Visual-Pitch att: increasing Bank att: roll Threat aircraft Aural-Chg. in aircraft sound *communication - WSO Control-Aileron, rudder and stabilator pressure Motion-Increasing positive G, pitching up, rolling	Determines high *closure rate and* need to continue turn	Maintains coordinated aileron, rudder and stabilator pressure; checks threat
K.	STARTS HARD DEFENSIVE TURN Visual-Pitch att: increasing Bank att: roll Threat aircraft Flt.Inst: cross-check Aural-Chg. in aircraft sound *communication - WSO Control-Aileron, rudder and stabilator pressure Motion-Increasing positive G pitching up, rolling	Determines need to start slicing turn into threat	Coordinates aileron and rudder pressure, moves stabilator
L.	CONTINUES DEFENSIVE TURN Visual-Pitch att: decreasing Bank att: roll Threat aircraft Aural-Chg. in aircraft sound *communication - WSO Control-Aileron and rudder pressure, increased stabilator pressure Motion-Increasing positive G pitching down, rolling	Determines need to continue hard defensive turn	Maintains aileron, rudder and stabilator pressure

SITUATION Defender in 60° turn, checking area at cruise power.

TASK NO. St-2 TASK Standard Training Task AIRCRAFT F-4E

TASK GOAL Perform Defender Roll Task DATE Feb., 1978

EL. SEQ.	1 CUES	2 MENTAL ACTION	3 MOTOR ACTION
M.	CONTINUES DEFENSIVE TURN Visual-Pitch att: decreasing Bank att: constant Threat aircraft Aural-Chg. in aircraft sound communication - WSO (Fox II call), AOA tone Control-Aileron, rudder and stabilator pressure Motion-Constant positive G, pitching down, rolling	Determines need to tighten turn to defeat missile shot	Maintains aileron pressure, moves stabilator
N.	STARTS MAXIMUM TURN Visual-Pitch att: decreasing Bank att: constant Threat aircraft Narrow vision onset Aural-Chg. in aircraft sound communication - WSO AOA tone Control-Aileron and stabilator pressure Motion-Increasing positive G pitching down, constant roll, buffeting	Determines threat is approaching lethal cone for a gunshot	Increases stabilator pressure
O.	CONTINUES MAXIMUM TURN Visual-Pitch att: constant Bank att: constant Narrow vision Aural-Chg. in aircraft sound AOA tone Control-Increased stabilator pressure Motion-Increasing positive G constant pitch and roll, increased buffeting, vibration	Determines maximum turn achieved and threat still closing	Maintains constant aileron and stabilator pressure
P.	STARTS JINK OUT Visual-Pitch att: constant Bank att: constant Gray out Aural-Chg. in aircraft sound communication - WSO (Fox III call), AOA tone Control-Aileron and stabilator pressure Motion-Constant positive G, constant pitch and roll, buffeting, vibration	Determines need for jink out	Moves stabilator and rudder

SITUATION Attacker in 2:00 position, 4-6,000 feet out, co-airspeed and altitude.

TASK NO. St-1 TASK Standard Training Task AIRCRAFT F-4E

TASK GOAL Perform Standard Task DATE Feb., 1978

EL. SEQ.	1 CUES	2 MENTAL ACTION	3 MOTOR ACTION
A.	SIGHTS TARGET AND PREPARES ATTACK Visual-Pitch att: level Bank att: level Target aircraft Aural-Normal aircraft sound, communication - WSO Control-Aileron, rudder & stabilator pressure Motion-Normal G	Determines need for AB and Master Arm Sustains level flight	Maintains required aileron & stabilator pressure, moves throttle, activates Master Arm
B.	PREPARES FOR PULL-UP AND ROLL Visual-Pitch att: level Bank att: level Target aircraft Aural-Chg. in aircraft sound Control-Aileron & stabilator pressure, throttle movement, Master Arm function Motion-Normal G, vibration, acceleration	Anticipates need for pull-up and roll Sustains level flight	Maintains aileron and stabilator pressure
C.	STARTS PULL-UP AND ROLL Visual-Pitch att: level Bank att: level Target aircraft Aural-Chg. in aircraft sound, communication - WSO *(aero call) Control-Aileron & stabilator pressure Motion-Normal G, acceleration	Determines need to begin pull-up and start roll to maintain Tally-Ho	Coordinates aileron and rudder, moves stabilator
D.	CONTINUES PULL AND ROLL Visual-Pitch att: increasing Bank att: rolling Target aircraft Aural-Chg. in aircraft sound, *communication - WSO Control-increased aileron, rudder & stabilator movement Motion-Increasing positive G, pitching up, rolling	Determines need to continue roll and pull	Maintains coordinated aileron, rudder & stabilator pressure

SITUATION Attacker in 2:00 position, 4-6,000 feet out, co-airspeed and altitude.

TASK NO. St-1 TASK Standard Training Task AIRCRAFT F-4E

TASK GOAL Perform Standard Task DATE Feb., 1978

EL. SEQ.	1 CUES	2 MENTAL ACTION	3 MOTOR ACTION
E.	CONTINUES ROLL AND PULL Visual-Pitch att: increasing Bank att: rolling Target aircraft Aural-Chg. in aircraft sound, communication - WSO (calls "radar brake lock") Control-Aileron, rudder and stabilator pressure Motion-Decreasing positive G, pitching up, rolling	Determines need to continue pull and roll to maintain target, calls target's position	Maintains coordinated aileron, rudder and stabilator pressure; communicates (calls target's position)
F.	CONTINUES ROLL AND PULL Visual-Pitch att: increasing Bank att: rolling Target aircraft Aural-Chg. in aircraft sound, communication Control-Aileron, rudder and stabilator pressure Motion-Decreasing positive G, pitching up, rolling	Determines proper roll rate and point approaching for pull down	Maintains coordinated aileron, rudder and stabilator pressure
G.	STARTS PULL DOWN Visual-Pitch att: decreasing Bank att: rolling Target aircraft Aural-Chg. in aircraft sound Control-Aileron, rudder and stabilator pressure Motion-Increasing positive G, pitching down, rolling	Determines proper point to begin pull down & need to call target's position	Coordinates aileron and rudder, moves stabilator, communicates (calls target's position)
H.	CONTINUES PULL DOWN Visual-Pitch att: decreasing Bank att: rolling Target aircraft Aural-Chg. in aircraft sound, communication Control-Aileron, rudder and stabilator pressure Motion-Decreasing positive G, pitching down, rolling	Determines proper pull down rate and need to continue pull down	Maintains coordinated aileron & rudder pressure, maintains stabilator pressure

SITUATION Attacker in 2:00 position, 4-6,000 feet out, co-airspeed and altitude

TASK NO. St-1 TASK Standard Training Task AIRCRAFT F-4E

TASK GOAL Perform Standard Task DATE Feb., 1978

EL. SEQ.	1 CUES	2 MENTAL ACTION	3 MOTOR ACTION
I.	STOPS PULL DOWN Visual-Pitch att: decreasing Bank att: rolling Target aircraft Aural-Chg. in aircraft sound, communication - WSO (calls "lock-on") Control-Aileron, rudder and stabilator pressure Motion-Decreasing positive G, pitching down, rolling	Determines proper pull down rate & need to activate pinkie switch	Maintains coordinated aileron and rudder pressure, maintains stabilator pressure, activates pinkie switch
J.	ESTABLISHES MAXIMUM CLOSURE RATE AND PROPER LEAD POINT Visual-Pitch att: decreasing Bank att: rolling Target aircraft Sight Aural-Chg. in aircraft sound, communication - WSO Control-Aileron, rudder and stabilator pressure; pinkie switch function Motion-Decreasing positive G, pitching down, rolling	Determines Fox II parameters approaching & need to unload for maximum closure rate	Maintains coordinated aileron and rudder pressure, relaxes stabilator pressure
K.	STARTS UNLOADED CLOSURE Visual-Pitch att: decreasing Bank att: rolling Target aircraft Sight Flt.Inst: cross-check Aural-Chg. in aircraft sound, *communication - WSO Control-Aileron & rudder pressure, reduced stabilator pressure Motion-Unloaded G, pitching down, rolling, acceleration	Determines rate of overtake and need to begin pull-up to target's plane	Maintains required aileron and rudder pressure, moves stabilator

SITUATION Attacker in 2:00 position, 4-6,000 feet out, co-airspeed and altitude

TASK NO. St-1 TASK Standard Training Task AIRCRAFT F-4E

TASK GOAL Perform Standard Task DATE Feb., 1978

EL. SEQ.	1 CUES	2 MENTAL ACTION	3 MOTOR ACTION
L.	CONTINUES CLOSURE RATE, FOX II PARAMETERS APPROACHING Visual-Pitch att: increasing Bank att: roll Target aircraft Sight Aural-Chg. in aircraft sound *communication - WSO Control-Aileron and rudder pressure, increased stabilator pressure Motion-Pitching up, rolling, increasing positive G	Determines Fox II parameters approaching (proper aspect angle)	Maintains required aileron, rudder and stabilator pressure
M.	MISSILE LAUNCH - FOX II Visual-Pitch att: increasing Bank att: rolling Target/Sight Aural-Chg. in aircraft sound, *communication - WSO Control-Aileron, rudder and stabilator pressure Motion-Decreasing positive G, pitching up, rolling	Determines proper Fox II parameters achieved and need to launch missile	Maintains required aileron, rudder and stabilator pressure; activates trigger; communicates (calls "Fox II")
N.	CONTINUES CLOSURE FOR HIGH ANGLE GUNSHOT (SNAPSHOT) Visual-Pitch att: increasing Bank att: rolling Target/Pipper Aural-Chg. in aircraft sound, communication Control-Aileron, rudder and stabilator pressure; trigger function Motion-Constant positive G, pitching up, rolling	Determines high closure rate and angle off, need to continue for a snapshot (Fox III), activates pinkie switch	Maintains required variable aileron and rudder control, moves stabilator, activates pinkie switch, deactivates trigger

SITUATION Attacker in 2:00 position, 4-6,000 feet out, co-airspeed and altitude

TASK NO. St-1 **TASK** Standard Training Task **AIRCRAFT** F-4E

TASK GOAL Perform Standard Task **DATE** Feb., 1978

EL. SEQ.	1 CUES	2 MENTAL ACTION	3 MOTOR ACTION
O.	CONTINUES ATTACK, FOX III Visual-Pitch att: constant °(variable) Bank att: °constant Target/Pipper Aural-Chg. in aircraft sound Control-Aileron, rudder and stabilator pressure; pinkie switch function; trigger function Motion-°Constant positive G, °constant pitch and roll	Determines Fox III parameters achieved and need for gunshot	Maintains required variable aileron, rudder, and stabilator pressure; activates trigger; communicates (calls Fox III)
P.	STARTS PULL-UP AND ROLL OFF Visual-Pitch att: increasing Bank att: rolling Target/Pipper Aural-Chg. in aircraft sound, communication Control-Aileron, rudder, and stabilator pressure; trigger function Motion-°Constant positive G, °constant pitch and roll	Determines need for immediate pull and roll away from target	Coordinates aileron and rudder, moves stabilator, deactivates trigger

APPENDIX H

SIMULATOR CAPABILITY REQUIREMENTS DATA

Instructors Information/Capability Requirements for
Task CR-1a, Air-to-Air Intercept/Single Turn Conversion (Page 1 of 5)

El. Seq.	Activity		Instructors Information/ Capabilities Requirements
A.	Receives GCI Commitment Against Target Aircraft	1	Display of target position
		2	Capability to start various initial condition (IC) geometrics
		3	Two-way comm. with pilot
B.	Prepares Turn to Attack Vector and Climbs to Combat Altitude	1	WSO function (radar lock-on achieved) by WSO or IP
		2	WSO scope presentation
		3	Monitors comm. from WSO (if WSO position included), two-way comm. if WSO not included
		4	Display of aircraft heading required for optimum intercept
		5	Capability to "fly" target
C.	Starts Roll In and Climb	1	Monitors comm. from WSO/performs WSO call of command heading
		2	WSO scope presentation
D.	Continues Roll In and Climb	1	Aircraft attitude/heading display
		2	Aircraft flight parameter display (mach, a/s, alt., vv, "g", aoa)
E.	Stops Roll In and Climb	1	Aircraft attitude/heading display
		2	Aircraft flight parameter display

Instructors Information/Capability Requirements for
Task CR-1a, Air-to-Air Intercept/Single Turn Conversion (Page 2 of 5)

El. Seq.	Activity	Instructors Information/ Capabilities Requirements
F.	Continues Turn/Climb	1 Aircraft attitude/heading display 2 Aircraft flight parameters display
G.	Starts Roll Out, Continues Climb	1 Monitors/performs WSO function (roll out call) 2 Intercept situation display (includes pictorial of all aircraft position, heading, mach, altitude and optimum heading for intercept) 3 Display of pilots radar scope 4 Aircraft attitude/heading 5 Aircraft flight parameters
H.	Continues Roll Out	1 Same as G, 2 thru 5 (above)
I.	Stops Roll Out, Continues Climb	1 Same as G, 2 thru 5 (above)
J.	Starts Level Off	1 Monitors/performs WSO functions (calls elevation and overtake) 2 WSO scope display 3 Same as G, 2 thru 5 (above)
K.	Completes Level Off	1 Same as G, 2 thru 5 (above)

Instructors Information/Capability Requirements for
Task CR-1a, Air-to-Air Intercept/Single Turn Conversion (Page 3 of 5)

El. Seq.	Activity	Instructors Information/ Capabilities Requirements
L.	Sets Combat Mach	1 Engine RPM display 2 Monitors/performs WSO function (calls target altitude) 3 Same as G, 2 thru 5 (above)
M.	Continues Intercept Vector	1 Performs GCI function (calls target hostile), two-way comm. 2 Armament status display (includes armament available, selection switches, & master arm status) 3 Same as G, 2 thru 5 (above)
N.	Continues Intercept Vector	1 Monitors/performs WSO function (calls "Judy") 2 Performs GCI function (acknowledges "Judy" call) 3 Same as G, 2 thru 5 (above) and M, 2 (above)
O.	Continues Intercept	1 Monitors/performs WSO functions 2 Same as G, 2 thru 5 (above) and M, 2 (above)
P.	Prepares Hard Turn to Target	1 Monitors/Performs WSO function 2 Same as G, 2 thru 5 (above and M, 2 (above)

Instructors Information/Capability Requirements for
Task CR-1a, Air-to-Air Intercept/Single Turn Conversion (Page 4 of 5)

El. Seq.	Activity	Instructors Information/ Capabilities Requirements
Q.	Starts Turn to Intercept Vector	1 Same as G, 2 thru 5 (above)
R.	Continues Roll In	1 Same as G, 2 thru 5 (above)
S.	Stops Roll In	1 Monitors/performs WSO function 2 Same as G, 2 thru 5 (above)
T.	Continues Turn	1 Same as G, 2 thru 5 (above)
U.	Starts Roll Out	1 Monitors/performs WSO function (calls roll out) 2 Same as G, 2 thru 5 (above)
V.	Continues Roll Out	1 Same as G, 2 thru 5 (above)
W.	Stops Roll Out	1 Same as G, 2 thru 5 (above)
X.	Prepares for Final Attack	1 Same as G, 2 thru 5 (above)
Y.	Presses Final Attack Steering	1 Same as G, 2 thru 5 (above)

Instructors Information/Capability Requirements for
Task CR-1a, Air-to-Air Intercept/Single Turn Conversion (Page 5 of 5)

El. Seq.	Activity	Instructors Information/ Capabilities Requirements
Z.	Continues Roll In to Final Attack	1 Monitors/performs WSO function (calls "you have the dot") 2 Same as G, 2 thru 5 (above)
AA.	Stops Roll In	1 Same as G, 2 thru 5 (above)
BB.	Continues Turn to Final Attack Vector	1 Monitors/performs WSO function (calls target range and launch range) 2 Same as G, 2 thru 5 (above)
CC.	Starts Roll Out on Attack Vector	1 Same as G, 2 thru 5 (above)
DD.	Continues Roll Out	1 Same as G, 2 thru 5 (above) 2 Same as BB, 1 (above)
EE.	Stops Roll Out	1 Same as G, 2 thru 5 (above)
FF.	Fires Aim-7 Missile	1 Performs/monitors WSO function (calls in range) 2 Scoring display of missile performance (hit or miss with reasons) 3 Same as G, 2 thru 5 (above) and M, 2 (above)

Capabilities Required for Implementation of Instructional Stragegies/Techniques

1. Capability to freeze problem for discussion, then operate from freeze condition.

2. Capability to instant replay part or all of training run.

3. Capability to debrief student with real time replay at instructor console displays.

4. Capability to replay previously flown intercepts for demonstration.

5. Capability of storing several different initial conditions for automatic sequencing from previous run.

6. Capability of instructor controlled Electronic Counter Measures (ECM) from target (jamming, chaff, flares, etc.).

7. Capability to make hard copy print of Cathode Ray Tube (CRT) displays at instructor or playback station.

APPENDIX I

MOTION BASE SYSTEM CALCULATIONS

1. Determination of positive cueing time available in vertical and lateral axes.

Total positive cueing time (T) is defined as the time to accelerate the cockpit to limit velocity plus the time to travel at limit velocity to the point at which washout must begin.

t_1 = time to accelerate to limit velocity.

t_2 = time to travel from point at which limit velocity achieved to point at which washout begins.

s_1 = distance traveled during t_1.

s_2 = distance traveled during t_2.

$S = s_1 + s_2 = 15$ inches

a = acceleration (.4g)

$a = .4(32.17)(12)$

$a = 154.4$ inches per second^2

V_L = velocity limit (24 inches per second)

Derivation

$$V_L = a\, t_1$$

$$t_1 = \frac{V_L}{a}$$

$$t_1 = \frac{24}{154.4}$$

$$t_1 = .155 \text{ second}$$

$$s_1 = \tfrac{1}{2}\, a\, t_1^2$$

$$s_1 = (\tfrac{1}{2})(154.4)(.155^2)$$

$$s_1 = 1.85 \text{ inches}$$

$s_2 = S - s_1$

$s_2 = 15 - 1.85$

$s_2 = 13.15$ inches

$s_2 = V_L \; t_2$

$t_2 = \frac{s_2}{V_L}$

$t_2 = \frac{13.15}{24}$

$t_2 = .548$ second

$T = t_1 + t_2$

$T = .155 + .548$

$T = .703$ second

2. For the longitudinal axis, where S equals 23 inches

$s_2 = S - s_1$

$s_2 = 23 - 1.85$

$s_2 = 21.15$

$t_2 = \frac{s_2}{V_L}$

$t_2 = \frac{21.15}{24}$

$t_2 = .881$ second

$T = t_1 + t_2$

$T = .155 + .881$

$T = 1.04$ seconds

3. For the pitch and roll axes

$a = 40$ degrees per second^2

$V_L = 20$ degrees per second

θ_1 = degrees traveled during t_1

θ_2 = degrees traveled during t_2

$\theta = \theta_1 + \theta_2 = 10$ degrees

Derivation

$V_L = a\ t_1$

$t_1 = \frac{V_L}{a}$

$t_1 = \frac{20}{40}$

$t_1 = .5$ second

$\theta_1 = \frac{1}{2} a\ t_1^2$

$\theta_1 = (\frac{1}{2})\ (40)\ (.5^2)$

$\theta_1 = 5$ degrees

$\theta_2 = \theta - \theta_1$

$\theta_2 = 10 - 5$

$\theta_2 = 5$ degrees

$t_2 = \frac{\theta_2}{V_L}$

$t_2 = \frac{5}{20}$

$t_2 = .25$ second

$T = t_1 + t_2$

$T = .5 + .25$

$T = .75$ seconds

APPENDIX J

SIMULATOR CAPABILITY/TASK REQUIREMENTS DATA

Task CR-5a, Low Yo-Yo
Cue Requirements/Availability Analysis

Skill	Visual Cues*	Available		% Individual Cues Available	% Total Cues Avail.
		Yes	No		
A	Pitch Att.(P.A.)	x			
	Bank Att.(B.A.)	x			
	Target (T.)-P**	x		100	100
B	P.A.	x			
	B.A.	x			
	T. - P	x		100	100
C	P.A.	x			
	B.A.	x			
	T. - P	x		100	100
D	P.A.	x			
	B.A.	x			
	Sight Bar(S.B.)	x			
	T. - P	x		100	100
E	P.A.	x			
	B.A.	x			
	S.B.	x			
	T. - P	x		100	100
F	P.A.	x			
	B.A.	x			
	S.B.	x			
	T. - P	x		100	100
G	P.A.	x			
	B.A.	x			
	S.B.	x			
	T. - P	x		100	100
H	P.A.	x			
	B.A.	x			
	S.B.	x			
	T. - P		x	0***	25
I	P.A.		x		
	B.A.		x		
	S.B.	x			
	T. - P		x	0	25

Footnotes:
* Aural, Control and Motion Cues required are provided by the simulator; therefore, they have been omitted from this listing, but included in calculations for % total availability.
** Primary Cue is denoted by "P".
***If Primary Cue is not available, % of individual cues available = 0 (See discussion in Step 3.)

Task CR-5a, Low Yo-Yo (cont'd)
Cue Requirements/Availability Analysis

Skill	Visual Cues*	Available Yes	Available No	% Individual Cues Available	% Total Cues Avail.
J	P.A.		x		
	B.A.		x		
	S.B.	x			
	T. - P		x	0	25
K	P.A.		x		
	B.A.		x		
	S.B.	x			
	T. - P		x	0	25
L	P.A.		x		
	B.A.		x		
	S.B.	x			
	T. - P		x	0	25
M	P.A.	x			
	B.A.	x			
	S.B.	x			
	T. - P		x	0	25
N	P.A.		x		
	B.A.		x		
	S.B.	x			
	T. - P		x	0	25
O	P.A.	x			
	B.A.	x			
	S.B.	x			
	T. - P	x		100	100
P	P.A.	x			
	B.A.	x			
	S.B.	x			
	T. - P	x		100	100
Q	P.A.	x			
	B.A.	x			
	S.B.	x			
	T. - P	x		100	100
R	P.A.	x			
	B.A.	x			
	S.B.	x			
	T. - P	x		100	100

Task CR-6a, Counter Low Yo-Yo
Cue Requirements/Availability Analysis

Skill	Visual Cues*	Available Yes	Available No	% Individual Cues Available	% Total Cues Avail.
A	Pitch Att.(P.A.) - P**	x		100	100
	Bank Att.(B.A)	x			
B	P.A.	x			
	B.A.	x			
	Target (T.) - P		x	0***	25
C	P.A.	x			
	B.A.	x			
	T. - P		x	0	25
D	P.A.	x			
	B.A.	x			
	T. - P		x	0	25
E	P.A.	x			
	B.A.	x			
	T. - P		x	0	25
F	P.A.	x			
	B.A.	x			
	T. - P		x	0	25
G	P.A.	x			
	B.A.	x			
	T. - P		x	0	25
H	P.A.	x			
	B.A.	x			
	T. - P		x	0	25

Footnotes:
* Aural, Control and Motion Cues required are provided by the simulator; therefore, they have been omitted from this listing, but included in calculations for % total availability.
** Primary Cue is denoted by "P".
***If Primary Cue is not available, % of individual cues available = 0 (See discussion in Step 3.)

Task CR-6a, Counter Low Yo-Yo (Cont'd)
Cue Requirements/Availability Analysis

Skill	Visual Cues*	Available Yes	Available No	% Individual Cues Available	% Total Cues Avail.
I	P.A.	x			
	B.A.	x			
	T. - P		x	0	25
J	P.A.	x			
	B.A.	x			
	T. - P		x	0	25
K	P.A.	x			
	B.A.	x			
	Flight Instruments(F.I.)	x			
	T. - P		x	0	25
L	P.A.	x			
	B.A.	x			
	T. - P		x	0	25
M	P.A.	x			
	B.A.	x			
	T. - P		x	0	25
N	P.A.	x			
	B.A.	x			
	T. - P		x	0	25
O	P.A. - P	x		100	100
	B.A.	x			
P	P.A.	x			
	B.A.	x			
	Narrowing Vision - P	x		100	100
Q	P.A.	x			
	B.A.	x			
	Grayout - P	x		100	100

Difficulty Index
Ranked in Order of Most Difficult
to Least Difficult

Low Yo-Yo			Counter Low Yo-Yo		
Rank	Skill	Training %	Rank	Skill	Training %
1	O	100	1	N	25
2	H	25	2	H	25
2	D	100	2	M	25
4	J	25	4	L	25
5	C	100	5	I	25
5	G	100	6	G	25
5	L	25	7	C	25
5	N	25	8	J	25
9	E	100	9	K	25
10	P	100	10	B	25
11	I	25	11	F	25
12	Q	100	12	O	100
13	M	25	13	D	25
13	R	100	14	E	25
15	K	25	15	A	100
16	B	100	15	P	100
17	F	100	17	Q	100
18	A	100			

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